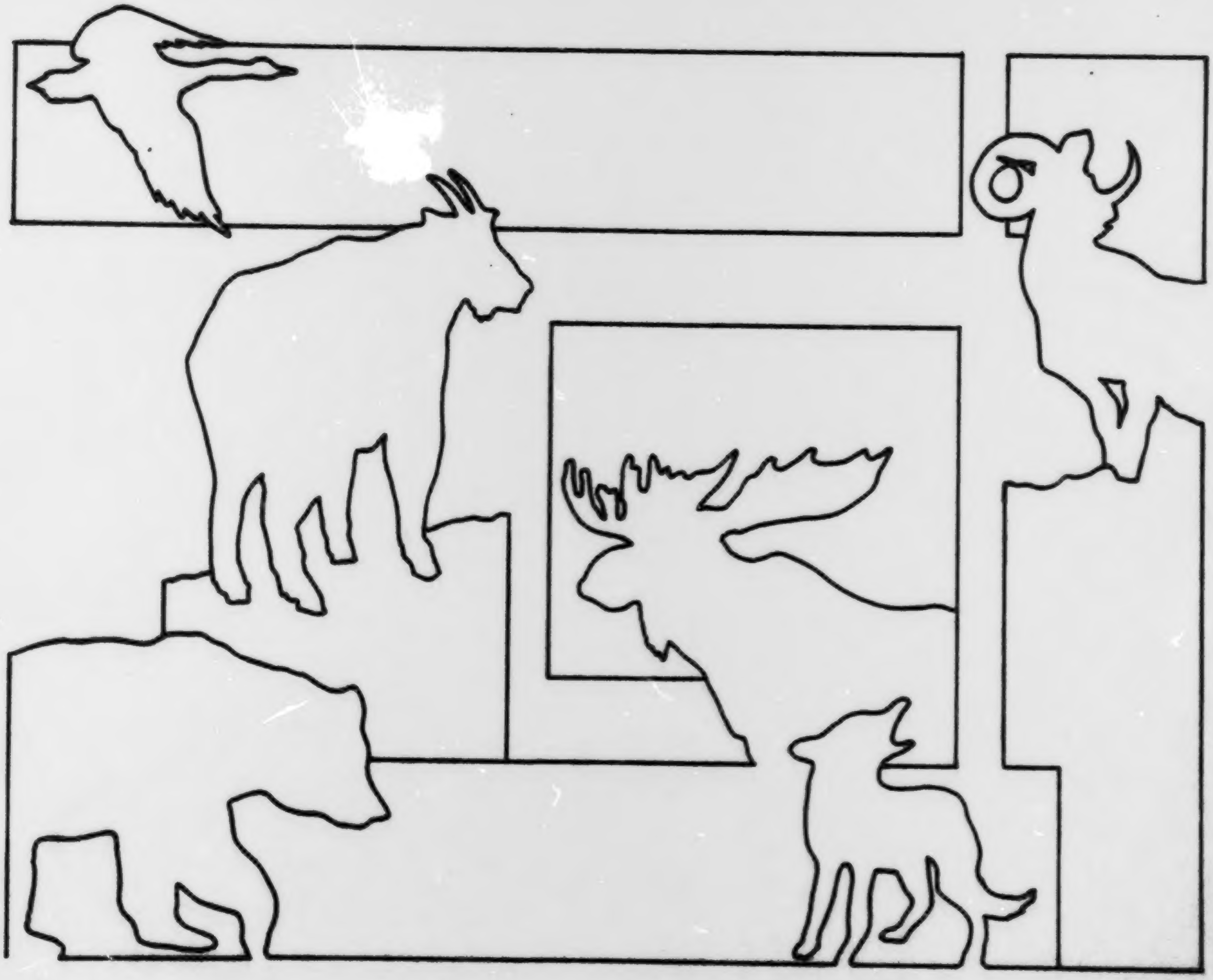
WILDLIFE

Spring Staging of Waterbirds at Early Open Water Sites in the Yukon River Basin

Project Report : Wildlife No. 4



YUKON
RIVER
BASIN
STUDY

This project was completed for the Yukon River Basin Study, an intergovernmental study funded by the governments of Canada, Yukon and British Columbia.

Environment Canada
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Pacific and Yukon Region

SPRING STAGING OF WATERBIRDS
AT EARLY
OPEN WATER SITES IN THE
YUKON RIVER BASIN

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SUMMARY

Investigations of spring migrant waterbirds (loons, grebes, ducks, geese and swans) using early open water sites in the southern Yukon River Basin were conducted during two seasons of spring migration. During the second year shorebird use of the sites was also investigated.

Briefly, the study objectives were:

1. to assess and compare the distribution and abundance of waterbirds at four intensively studied sites, and at other open water sites identified during extensive aerial surveys;
2. to identify important areas and habitats to waterbirds within the intensive study sites;
3. to assess waterbird behaviour at the sites and their use of available habitat.

Intensive ground surveys of waterbird distribution, abundance, habitat use and behaviour at four open water areas (Marsh Lake, Tagish Lake, Teslin Lake and Little Atlin Lake outlets) were conducted from 16 April - 20 May 1982 and 5 April - 26 May 1983. Aspects of the physical and biological habitat available to spring migrants were assessed. Additionally, aerial surveys of the British Columbia portion of the Yukon River Basin were flown to identify early open water sites used by spring migrant waterfowl. The surveys were flown on 8 May 1982 and 28 April 1983, roughly coinciding with peak waterbird migration through the general area.

In 1982 spring thaw was unusually late and in 1983 spring thaw was early. These weather variations were reflected in the timing and patterns of spring migration. Generally, spring waterbird migration was 19 days later in 1982 than 1983, although variation existed between species and species groups.

The arrival of the first migrants (Trumpeter Swans) differed by

15 days between the two years (12 April 1982 and 28 March 1983). Migrant waterbirds were present at the staging sites until late May during both years. The maximum time period which these sites could potentially be used by spring migrants is eight weeks, extending from late March to late May.

During an early spring, the length of time from first arrival to peak abundance of waterbirds was shorter: 25 days in 1982 versus 16 days in 1983. Peak waterbird abundance occurred on 10 May in 1982 and 23 April in 1983. The magnitude of peak abundance was approximately 10,000 birds in 1982 and approximately 8500 birds in 1983.

Species-group (ducks, geese, swans) composition during waterbird peak abundance differed between the two springs. Although ducks comprised the greatest proportion of the waterbirds during both springs, in the late spring (1982) they represented 93% of the total birds and 51% in the early spring (1983). Swans represented 14% of the total birds during peak abundance in 1982 and as much as 48% in 1983.

The timing of peak abundance differed between species-group between the two years. Swans and geese, the earliest migrants, showed the least difference in timing of peak abundance between the two springs (5 and 4 days respectively). Peak swan abundance was on 27 April in 1982 and 22 April in 1983. Peak goose abundance was on 22 April in 1982 and 18 April in 1983. Dabbling ducks reached peak abundance 20 days earlier during the early spring (12 May 1982 versus 22 April 1983). The timing of peak abundance of diving ducks was 19 days earlier during the early spring (15 May 1982 versus 26 April 1983). Peak abundance of loons and grebes was noted on 16 May in 1982 and on 5 May in 1983.

A total of 33 waterbird species were recorded at the four intensive staging sites over the two years. Differences in diversity between years (31 species in 1982 and 28 species in 1983) and between sites is attributable to the presence/absence of rare species. The more common species were: Trumpeter and Tundra Swans, Green-winged Teal, American Wigeon, Mallard, Northern Pintail, Canvasback, Scaup spp. and Common Goldeneye. Some of the rare species include: Snow Goose, White-fronted Goose, American Black Duck, Blue-winged Teal, Cinnamon Teal, Eurasian Wigeon, Hooded Merganser and Oldsquaw. Maximum species diversity was from 15 - 20 May in 1982 and 3 - 13 May in 1983.

Ducks represented at least 73.1% of the total waterbirds censused during both years. Dabbling ducks comprised at least two-thirds of this proportion. Swans represented 8.2% of the total waterbirds in 1982 and 24.5% in 1983. Geese, mergansers, loons and grebes each represented less than 5% of the total birds.

Significant differences in species-group abundance was tested using two-sided paired t-tests. Abundance of essentially all groups at Little Atlin was significantly different from the other three sites. Significant differences in species-group abundance among the three major sites (Marsh, Tagish and Teslin) varied by year and between sites.

In terms of abundance, expressed as waterbird-use days, the Tagish site had the greatest bird use (60,133 use days) during the late spring (1982) and during the early spring the Marsh site had the greatest use by birds (64,429 use days). During converse years each site had approximately 40,000 use days. The Teslin site received 29,899 and 27,035 waterbird-use days in 1982 and 1983 respectively. The Little Atlin site received only 9,000 use days in 1982. Swan-use days were greatest at the Marsh site during both years (5,950 and 21,728).

Within each site birds used the zones differently. At the Marsh site, zone 7 or the lake outlet received the heaviest bird use. At least 70% of the total bird observations occurred in zone 7. Most of the waterbirds (at least 67.9%) counted at the Tagish site were in zone 1, Marsh Lake inlet. Bird use of zones at the Teslin site differed between years. In 1982, 32.9% of the birds were in zone 2 (Teslin River), 28.7% were in zone 4 (Teslin Lake outlet), 22.5% were in zone 1 (Teslin River) and 15.9% were in zone 3 (Teslin River). In 1983, most of the birds (52.5%) were in zone 4, the lake outlet.

Waterbirds used all but 3 of the 79 identified open water areas surveyed in the British Columbia portion of the Yukon River Basin. The mean number of waterbirds per individual site was 49 and 81 birds, in 1982 and 1983 respectively. All of the open water sites had a smaller areas of open water than the intensively studied sites. However, the open water areas of the Jennings, Swift and Teslin River outlets, Torres channel and the Hutsigola Lake region, all had significant numbers of waterbirds. Most of the 415 Canada Geese observed during the 1983 survey were observed at open water sites on the Teslin River.

During the aerial survey in 1982, most of the open water sites (41%) and most of the area of open water (45%) were river outlets. Correspondingly, most of the birds (36%) were noted at river outlets. Lake channels represented 34% of the open water area and 33% of the birds. However, waterfowl density was greatest (27.4 birds/ha) at river inlets, in 1982. In 1983, river outlets again represented the greatest proportion (36%) of waterbirds. More open water was available in 1983 during the time of the survey and more birds were present than in 1982.

During 1982 and 1983, most (over 90%) of the waterfowl surveyed were ducks. In 1982 geese and swans each represented 2% of the total birds. In 1983 the survey was expanded and geese and swans represented 7 and 1% of the total birds, respectively.

Investigations of types and amount of physical habitat available

at the intensively studied sites revealed that the Marsh and Tagish sites had the greatest amount of open water during spring staging. However, unlike the Tagish site, at least 50% of the open water at the Marsh site was shallow water ($<$1m deep). The area of exposed mudflat was extensive at the Marsh and Tagish sites, but was greatest at the Teslin site.

Year to year differences in spring weather conditions affected the amount and timing of availability of habitat types (open water, shallow water, exposed mudflats, shore/water interface, ice/water interface). In late April the amount of open water at each site was comparable between springs. However, essentially no mudflats were exposed in late April 1982, compared with approximately 30 ha of mudflats in late April 1983.

During the late spring the lake ice remained longer. On 9 May 1982 the lake ice was still land fast at all sites, while on 11 May 1983 ice on Tagish and Teslin Lake had broken up and the lakes were open. The rate of change of ice melt and exposure of mudflats was greatest during 1983.

Lake outlets and inlets offer expanses of shallow water and exposed mudflats while rivers tend to have limited areas of both these habitats. Teslin River is an exception as it provides ledges of shallow water and large mudflat areas in early spring. Lake water levels are characteristically lowest in the spring. The significance of the low water levels is that it allows and makes available food sources and feeding and loafing areas to spring migrant waterbirds.

Cursory sampling of aquatic macrophytes at the staging sites revealed pondweed, _Potamogeton_ spp. was common to all sites and was well represented. Horsetails, _Equisetum_ spp. were characteristic of the

Little Atlin site. Mare's tail, Hippuris vulgaris was found only at the Marsh site. Preliminary plant biomass sampling was conducted at the Marsh, Tagish and Teslin sites in late May 1983. No conclusions can be drawn at this point. Waterbirds at the sites presumably eat plant tubers and root systems as well as insects, both in the water column and in the water pools on the mudflats.

A forward step-wise multiple regression was used to test the relationship of different habitat types to waterbird numbers. In 1982, at the Marsh site only, the area of mudflat accounted for most of the variation in waterfowl numbers between zones. In 1983 at the Marsh and Tagish sites, the area of shallow water and mudflat were the two most important variables. However, the generally low R-squared values (except Marsh 1982) suggest waterbird distribution is also attributable to other untested variables.

Behaviour activity and habitat use of waterfowl is discussed by species and species-group. At all sites, dabbling ducks fed more often than loafed (resting). Feeding habitat varied between sites. Loafing habitat included ice edges in the late spring, and mudflats and shallows in the early spring. Diving ducks loafed more often than fed, however feeding activity may have been underestimated. Open water provided loafing and feeding habitat for most divers. More swans fed than loafed, and more feeding activity was noted in 1983 than in 1982. Feeding habitat varied from site to site but was principally less than 10 m from the shore or ice edge, and open water. Loafing habitat included areas less than 10 m from the ice edge and ice.

The first shorebirds at the staging sites were noted on 26 April in 1983. Shorebird numbers remained low until 9 May. Peak abundance occurred on 18 May: 841 shorebirds at Marsh, 630 at Tagish and 92 at Teslin. Numbers declined rapidly after 18 May.

Pectoral Sandpipers were the most abundant shorebird and comprised at least 50% of the total observed at each site. Other common species included: dowitcher spp., Semi-palmated Sandpiper, Least Sandpiper and Lesser Yellowlegs. The greatest shorebird diversity was at the Marsh site.

Shorebirds were most abundant at the zones with expansive mudflats at each site. Shorebirds were most abundant at zones 7 and 3 at Marsh, zone 1 at Tagish and zone 4 at Teslin.

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INTRODUCTION

During 1982 and 1983 spring migrant waterbird abundance and habitat use were studied at several staging sites within the southern Yukon Territory and northern British Columbia, in the Yukon River Basin. The study was commissioned by the Canadian Wildlife Service and funded by the Yukon River Basin Study, a joint government (federal, provincial and territorial) committee coordinating studies investigating various facets of the Yukon River Basin.

The headwaters of the Yukon River are a series of large lakes in the south-central Yukon Territory and northern British Columbia. The outlets of these lakes (as well as lakes elsewhere in the river basin) are characteristically ice-free by early spring, well in advance of the general spring thaw, and during mild winters remain open year round (Mossop 1976). The major ice-free open water areas identified in the Yukon River Basin (Mossop 1976) include the outlets of Marsh Lake, Teslin Lake, Big Salmon Lake, Lake Laberge, Bennett Lake, Kluane Lake, and Little Atlin Lake.

During spring migration, waterbirds arrive at the open water areas of the lake outlets at a time when little or no other open water exists in the region nor at latitudes further north. Trumpeter swans (Cygnus buccinator), harbingers of spring to the Yukon, are the earliest arrivals, arriving in late March to mid-April when mean daily temperatures are below 0°C. By mid-April to mid-May, coinciding with peak waterbird migration these open water areas have substantially increased in size, still well in advance of the general spring breakup.

The various processes which influence the early open water areas at northern lake outlets are not thoroughly understood (Carmacks pers. comm.). Generally, due to the shape and shallowness of the lake outlets and consequent lake currents, the warmer, 4°C water from the lake bottom rises and mixes with the colder upper waters, thereby raising the water temperature near the surface. Carmacks termed this process "selective withdrawal". Depending upon the ambient air temperature, the raised water temperature may be sufficient to affect ice conditions, thus creating an area of open water. This warmer water also affects downriver ice conditions.

Since 1976, a number of studies have documented the utilization of the early open water areas by migrant waterbirds (Mossop 1976; Foothills Pipelines (Yukon) Ltd. 1977, 1978; Milligan 1978; Anweiler and Blood 1981). These studies addressed the question of how many birds utilized the lake outlets, although the census methods used, varied (i.e. aerial survey, ground survey, systematic, sporadic) between the studies. The present study was designed to further describe waterbird use of certain lake outlets at the species level and to investigate how birds used the open water areas.

This report presents the results of the study of spring migrant waterbird abundance, behaviour and habitat use at Marsh, Tagish, Teslin and Little Atlin Lake outlets, as well as spring waterbird use of other areas within the southern Yukon River Basin. During 1982, spring thaw was unusually late. Since waterbird abundance and patterns of use at lake outlets in 1982 were not representative of trends during more typical spring conditions, an additional year of investigations was conducted. Thus, the second year of study allows a wider range of conditions for comparing and evaluating the use of the open water areas by waterbirds during spring migration.

The objectives of the study were:

1. to record and compare the abundance and distribution of waterbirds at Teslin, Marsh, Tagish and Little Atlin Lake outlets during the spring staging period;

2. to identify the location and compare the amounts of various biophysical habitat types potentially important to waterbirds and available within each of the four staging sites;

3. to assess the waterbird use-patterns of the habitats identified at the four staging sites;

4. to assess the utilization of Teslin, Marsh, Tagish and Little Atlin Lake outlets by spring migrant shorebirds, in terms of their documented abundance and distribution;

5. through an aerial reconnaissance survey assess the waterbird use of early open water areas in the northern British Columbia waters of the Yukon River drainage.

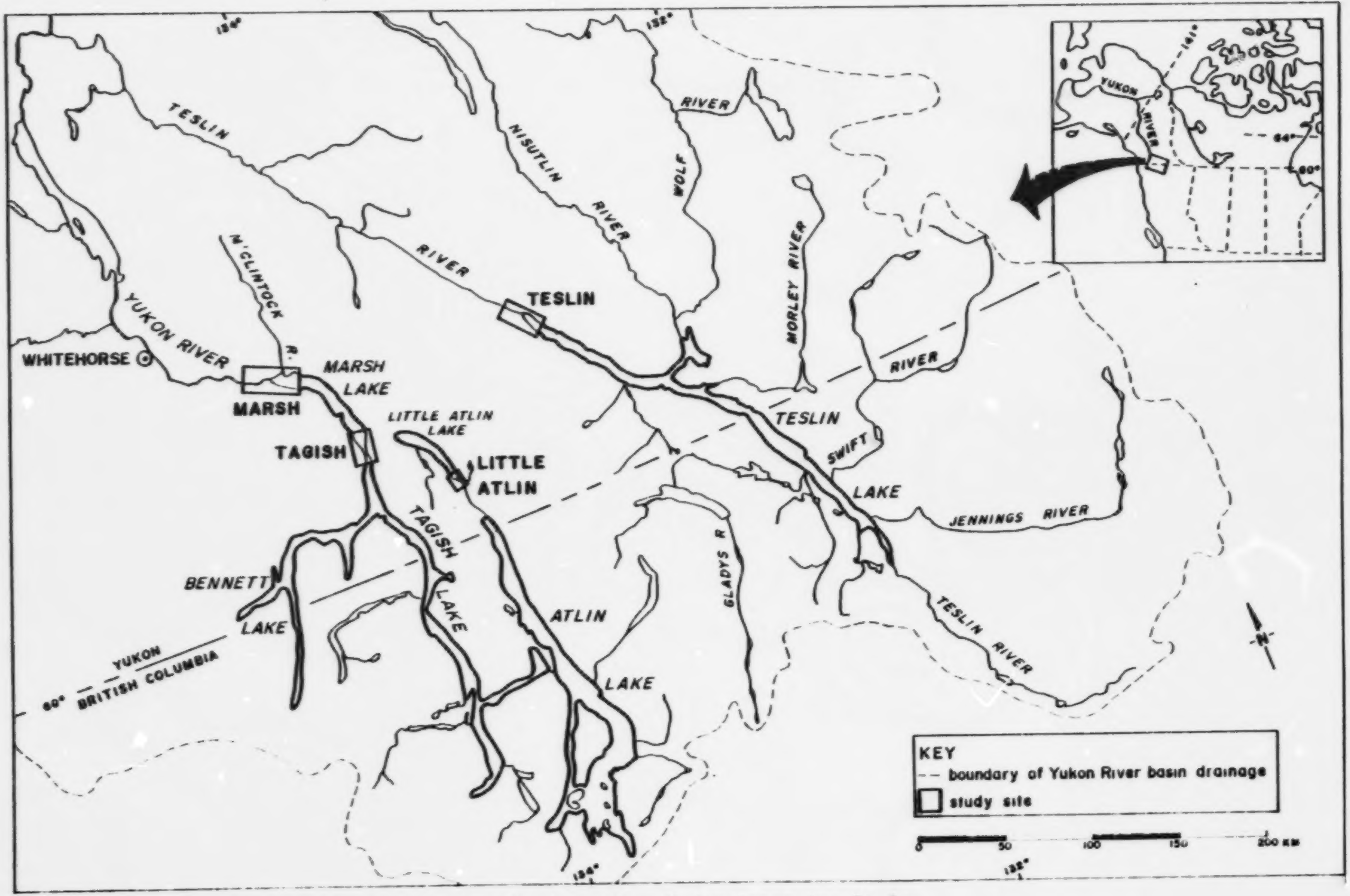
STUDY AREA

The study area encompasses the upper headwater rivers and lakes of the Teslin and Yukon Rivers (Figure 1). These two large rivers drain the most southerly one third of the Yukon River Basin. Both river systems find their headwaters at the outlets of major lakes. The Teslin River, which eventually flows into the Yukon River, drains Teslin Lake which in turn is fed by numerous rivers which are the Nisutlin, Morley, Swift, Jennings, Gladys and (upper) Teslin Rivers. Although many of these rivers originate in mountainous terrain, none are of glacial origin. The Yukon River which originates in Marsh Lake, drains an array of interconnected large, deep lakes which are: Atlin, Little Atlin, Tagish, Tutshi, Bennett and Marsh Lakes. These lakes abutt the Coastal Mountains and are essentially fed by small creeks and glacial rivers.

Aerial surveys, designed to document as many open water areas as possible, were flown over headwater rivers and lakes in the British Columbia (B.C.) portion of the Yukon River Basin. In 1982, the surveys concentrated on the headwater lakes and rivers of the Yukon River while the 1983 surveys were extended eastward to include headwater rivers and lakes of the Teslin River drainage.

The main focus of the study concentrated on four early open water areas at the outlets of Marsh, Tagish, Teslin and Little Atlin Lakes. Three of these sites, Marsh, Tagish and Teslin, were considered major staging areas for migrant waterbirds (Mossop 1976).

The Little Atlin site is the smallest of the four intensive study areas (80 ha). The site is located at the south end of Little Atlin Lake (60°15'N, 134°0'W) where the lake empties into the Lubbock River (Figure 2). The early open water area extends from the lake outlet, 1 km downriver on the Lubbock River. Although this open water area is very small, this site is likely representative of many of the smaller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WOLF
RIVER
MORLEY RIVER
RIVER
TESLIN
M'CLINTOCK
R.
YUKON RIVER
WHITEHORSE
MARSH
LAKE
MARSH
TAGISH
LITTLE ATLIN
LAKE
LITTLE
ATLIN
TESLIN
SWIFT
LAKE
JENNINGS RIVER
GLADYS R
TAGISH
LAKE
ATLIN
LAKE
BENNETT
LAKE
YUKON
60° BRITISH COLUMBIA
TESLIN RIVER
N
KEY
boundary of Yukon River basin drainage
study site
0
50
100
150
200 KM
134°
132°
YUKON
RIVER
141°
64°
60°

Figure 1 Locations of the Four Spring Staging Sites Under Intensive Study.

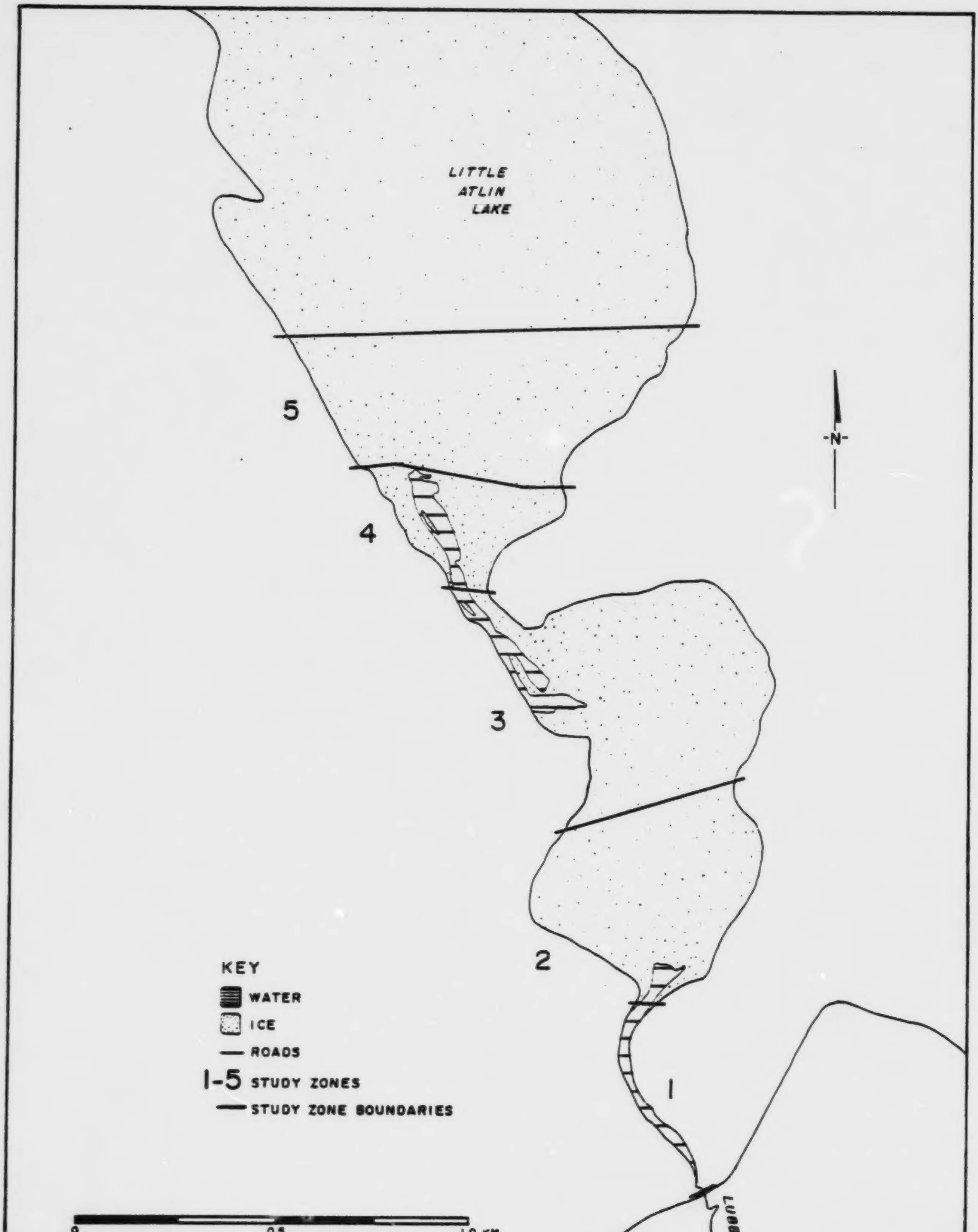

LITTLE ATLIN LAKE
5
4
3
2
1
-N-
KEY
WATER
ICE
ROADS
1-5 STUDY ZONES
STUDY ZONE BOUNDARIES
0
0.5
1.0 KM
LUBBOCK R.

Figure 2 Little Atlin Study Area with Locations of Zones Marked.

early open water sites throughout the study area. The site is relatively undisturbed with no human habitation within 4 km of the open water. A dirt access road to the Lubbock River Valley Farms crosses the Lubbock River 1 km below the lake outlet; however the road received little use during the spring staging period.

The Teslin site (60°32'N, 133°24'W) extends from the open water area at the outlet of Teslin Lake, downriver 4 km to a point 1 km downstream of the Alaska Highway bridge at Johnsons Crossing (Figure 3). The site covers an area of approximately 550 ha of potentially open water during the spring staging period.

During most winters, the lake outlet and at least 5 km of the river are ice-free (Mossop 1976). The community of Johnsons Crossing is located adjacent to the Alaska Highway bridge. There are no developments upriver of the bridge nor at the lake outlet, however local residents from Johnsons Crossing and Teslin set nets by motorboat on a day-to-day basis at the lake outlet throughout the spring staging period. Considerable numbers of vehicles cross the Teslin River via the Alaska Highway bridge at Johnsons Crossing.

The Marsh site (60°30'N, 145°45'W) is the second largest (<800 ha) of the four study sites. It extends from the early open water at Marsh Lake outlet, 11 km downriver to a point 1.5 km past the Northern Canada Power Commission (NCPC) control dam (Figure 4). Water levels at the lake outlet are influenced by the NCPC control dam.

The Marsh site is unique because the lake outlet includes a major river mouth. The M'Clintock River flows into Marsh Lake outlet and forms an extensive delta. The silty, brown coloured water of the M'Clintock River contrasts sharply with the clear waters of Marsh Lake.

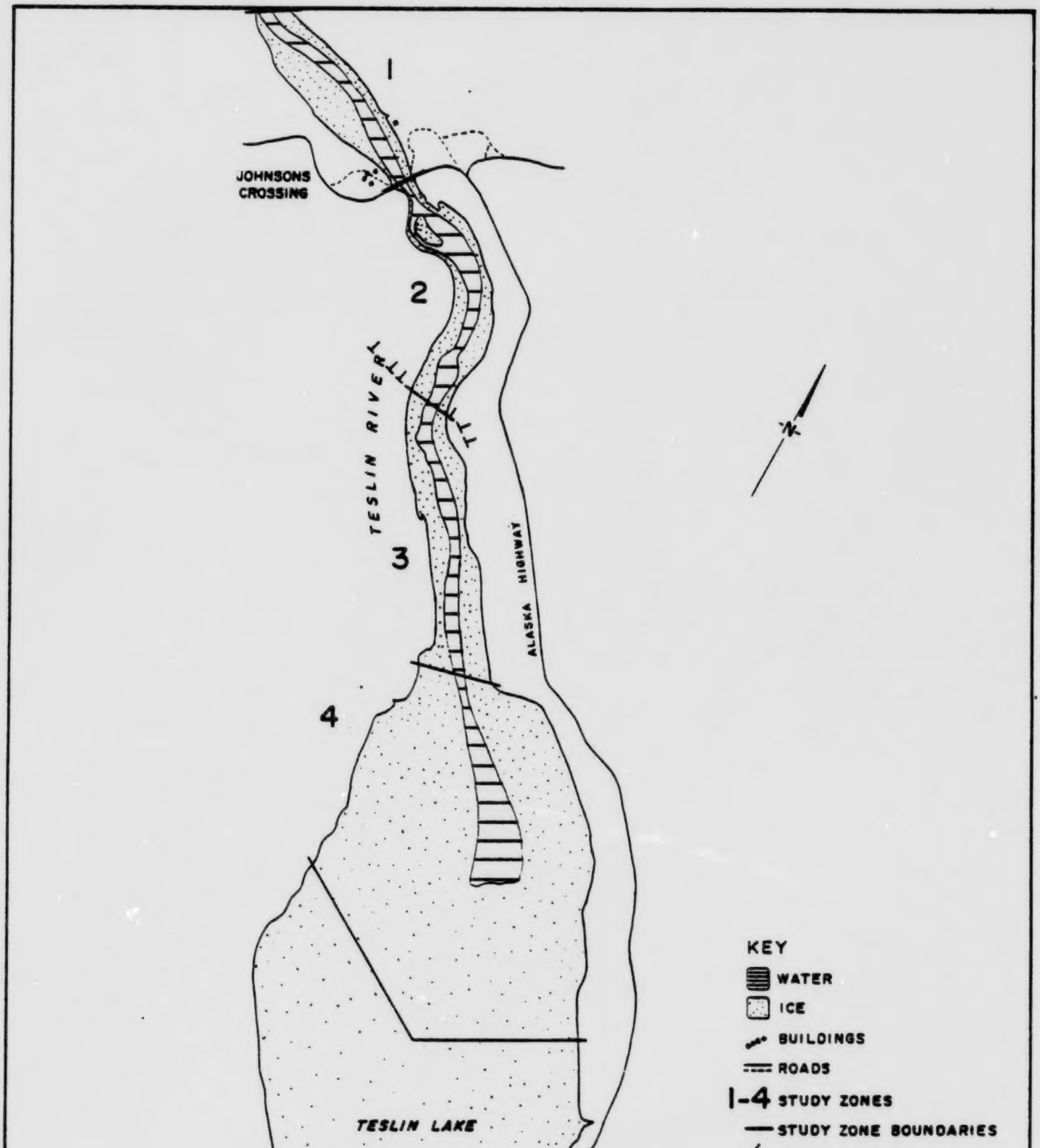

1
JOHNSONS CROSSING
2
TESLIN RIVER
3
ALASKA HIGHWAY
4
N
TESLIN LAKE
BROOKS BROOK
KEY
WATER
ICE
BUILDINGS
ROADS
1-4 STUDY ZONES
STUDY ZONE BOUNDARIES
POWER LINE
0
0.5
1.0
2.0 KM

Figure 3 Teslin Study Area with Locations of Zones Marked.

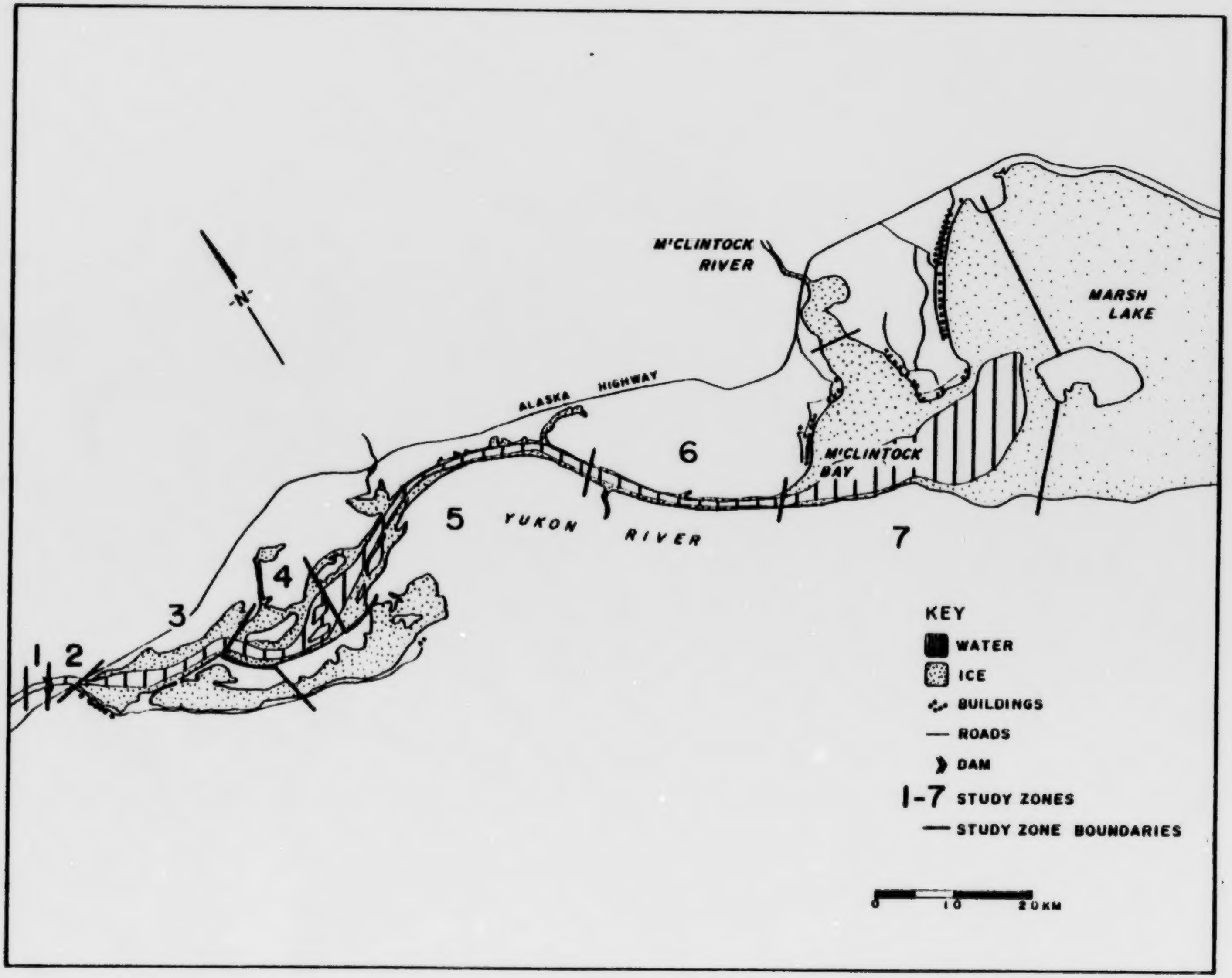

N
M'CLINTOCK RIVER
MARSH LAKE
ALASKA HIGHWAY
M'CLINTOCK BAY
YUKON RIVER
1
2
3
4
5
6
7
KEY
WATER
ICE
BUILDINGS
ROADS
DAM
1-7 STUDY ZONES
STUDY ZONE BOUNDARIES
0
10
20KM

Figure 4 Marsh Study Area with Locations of Zones Marked

Recreational and permanent residences are numerous at M'Clintock Bay, eastward along the north shores of Marsh Lake and on the south shores of the Yukon River upriver of the NCPC control dam (see Dennington 1981). Boat traffic on M'Clintock Bay and the Yukon River can be considerable during the spring staging period.

The Tagish site (60°17'N, 134°16'W) includes both a lake outlet (Tagish Lake) and a lake inlet (Marsh Lake), connnected by 8 km of the Tagish River (Figure 5). The Tagish site is the largest of the four sites, covering approximately 850 ha of potentially open water. Water levels at this site are influenced by the NCPC control dam on the Yukon River. Tagish Creek empties into the Tagish River at a point 0.5 km upriver of Marsh Lake inlet and forms a lagoon of shallow water and mudflats.

Development of cottages and a few permanent domiciles is extensive along the shores of the river and Tagish Lake outlet (see Dennington 1981). A territorial government campground and a marina are situated along the east shore of the river adjacent to the Tagish bridge which spans the river 1 km upriver of Marsh Lake inlet (Figure 5). Occasional boat traffic on the river and lake inlet is common during May.

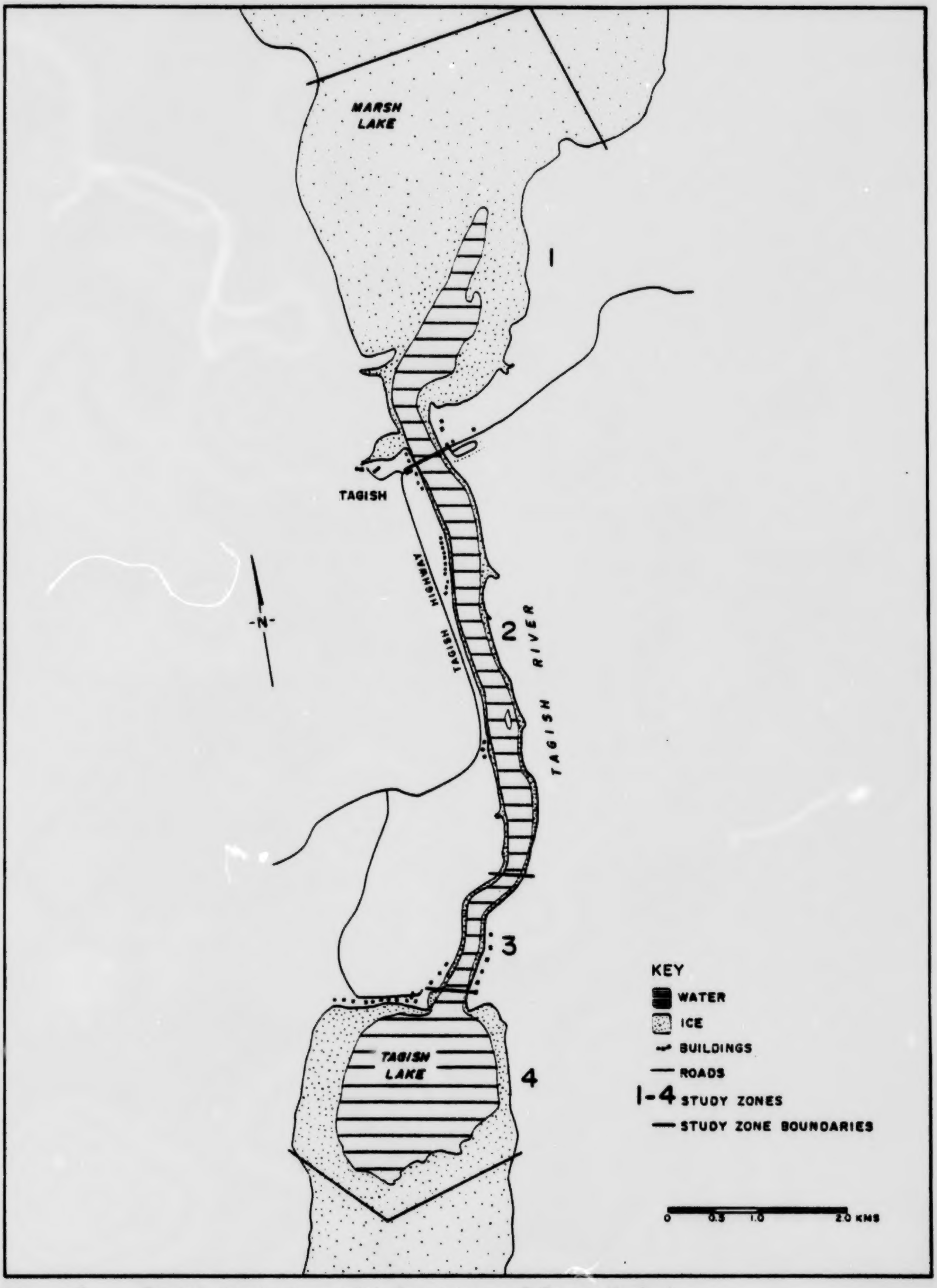

MARSH LAKE
1
TAGISH
TAGISH HIGHWAY
-N-
2
TAGISH RIVER
3
TAGISH LAKE
4
KEY
WATER
ICE
BUILDINGS
ROADS
1-4 STUDY ZONES
STUDY ZONE BOUNDARIES
0
0.5
1.0
2.0 KMS

Figure 5 Tagish Study Area with Locations of Zones Marked.

METHODS

Census Methods at Intensive Study Sites

Ground censuses of waterbird abundance were conducted at approximately four day intervals at each study site (Appendix 1). The census period was from 16 April to 20 May in 1982 at all four sites. In 1983 the longer census period extended from 5 April to 26 May. Not all study sites received equal coverage in 1983. No counts (censuses) were conducted at the Teslin site after 22 May 1983 since waterbird abundance was virtually nil by that date. At Little Atlin only 3 censuses were conducted in 1983 as the 1982 results suggested this site was of minor importance to waterbird migrants, relative to the other three study sites. A census of birds at the four sites required one or two consecutive days to complete, depending on the number of birds present.

To investigate the spatial use of areas by waterbirds within an individual study site and to allow manageable areas for accurate census, each site was divided into zones based on areas of similar physiography. Each of the study sites was divided into zones corresponding to lake outlets, lake inlets and river channels. The Marsh Lake site was divided into seven zones (Figure 4), one lake outlet zone and six river zones. The Tagish site (Figure 5) was divided into two river zones, one lake outlet (Tagish Lake) and one lake inlet (Marsh Lake) zone. The Teslin site (Figure 3) contained three river zones and one lake outlet zone. At Little Atlin, the site was divided into a river zone, a lake outlet zone and three lake narrows zones (Figure 2). The specific biophysical details of zones within each site are discussed in a subsequent section.

To insure accurate counts and thorough coverage of a site, the censuses were conducted from several strategic vantage points along the shores of each zone. Two observers initially worked together as recorder and observer; then, as waterfowl numbers increased, they worked independently to insure thorough and rapid coverge of all sites within one-two days. Each observer used 7x35 binoculars and 15-60x spotting scopes to aid waterbird identification. Data were recorded into notebooks or onto cassette tape. Field notes or tapes were then transcribed onto computer formatted coding sheets. All bird names conform to the most recent American Ornithologists Checklist (AOU 1982). Scientific names of waterbirds recorded during the study are appended (Appendix 2).

Behaviour and Habitat Use

During a census, the species, age and sex (when possible), location by zone, behaviour activity and habitat associations for each bird were recorded. Behaviour classes were feeding, loafing (preen, stand, sleep, swim), courtship and agonistic behaviour, and flying. Habitat classes consisted of two open water classes (> 10 m from shore, >10m from ice-edge), two near-shore water classes (< 10 m from shore or <10m from ice-edge), on shore, on ice and on islands. It was not always feasible to place all birds into habitat and behaviour activity classes. On occasion, large numbers of birds, or disturbance of the birds by predators or boats precluded accurate assessment of activity and habitat use. In such cases, priority was given to obtaining accurate counts of birds present. In addition to bird records, ice conditions, mudflat exposures and open water areas at each zone were sketched onto enlarged topographical maps.

Waterfowl Activity Budgets

Intensive behaviour watches were conducted at each site for the more common waterfowl species (Appendix 3). Using the methods of Altmann (1973), groups of waterfowl were scanned at 15 minute intervals and the instantaneous behaviour of each individual bird and its habitat was recorded. One scan sample of a flock required 5 to 10 minutes to complete. Fifteen minute intervals were chosen to facilitate the scanning of a fairly large number of birds. To yield a representative sample, sampling within a site was stratified over the various types of zones (i.e. outlet, river, inlet) and was conducted at areas where waterfowl concentrated.

Determination of Physical Habitat

Aerial photography was used to estimate the availability of selected habitats to waterbirds at each site. Overflights, which covered all zones within each site, were flown on 22 April and 9 May in 1982 and on 26 April and 11 May in 1983. In 1982, the 22 April survey occurred when the numbers of spring migrants totaled <500 birds at all sites, while the 9 May survey corresponded to peak numbers of waterbirds (10,000). The 1983 surveys occurred after peak numbers of birds were recorded at the sites, however there were still >5,000 and >1,200 birds at the sites during the two surveys on 26 April and 11 May, respectively. No aerial photo reconnaissance was flown over the Little Atlin site in 1983.

During 1982, the two aerial photo reconnaissance flights were flown in a Maule fixed-wing aircraft at an altitude of 1600 and 2100 m agl. Aerial photo reconnaissance was flown in a DHC-3 (single-engine Otter) during 1983 at an altitude of 2300 m agl. In both years, a 35 mm semi-automatic camera with a wide-angle lens (28 mm) was used to take photographs perpendicular to the ice and water. On the first reconnaissance flight of 22 April 1982, black and white film was used; thereafter 100 ASA colour film was used which gave better resolution and revealed major differences in water depth within each site.

Habitat features whose area or length was estimated from the aerial photographs included: total area of ice-free water, total area of shallow water (< 1 m deep), total area of exposed shore, length of ice- edge/water interface, and length of shore-edge/water interface. In order to measure the area or length of these habitats, the printed 35 mm images from each aerial survey were pieced together into a composite of an entire study site. A pencil copy was traced of the boundaries of each habitat and the area of each habitat was determined from the pencil copy using a compensating polar planimeter, or its length was measured with a map measuring wheel.

To determine areas of shallow water, the colour of the water on the photos was checked against known water depths obtained during vegetation and bathymetric sampling. All areas on the photographs with similar water colour(s) to those determined for water <1 m deep were delineated as shallow water. Exposed shore corresponded to ice-free mudflats between the water's edge and receding ice-edges, or to the edge of the highwater mark. Shore/water interfaces were all exposed shorelines free of ice, including island shorelines. The ice/water interface was defined by ice-edges which abutted water; however this parameter did not include ice-edges which were receding across exposed shorelines.

Vegetation and Bathymetric Sampling

In 1982, vegetation sampling at the four sites was preliminary and intended to present a general overview of the available plant foods to spring migrating waterbirds. Sampling areas were chosen to be representative of waterbird feeding areas. Sampling was conducted in mid-May to determine if any new-growth, above-ground submergent vegetation was available. The areas were sampled again in late summer to identify what species or genus of aquatic vegetation grew at the specific study sites.

During the mid-May 1982 sampling, in specific sites where visibility was limited by turbid water, a diver was used to determine what aquatic vegetation was present. During spring and summer sampling the percent of plant cover was estimated and plants were identified to genus or species or collected for identification. Water depth was measured, concurrent with percent cover estimates of aquatic plant species, every five metres along a transect line laid perpendicular to the shoreline, on the water's surface. Transect length varied between sites from 95 to 340 m. The cover value of each plant species was determined from a visual estimate of the percent of cover in a 1 m plot, using a 7-class scheme for cover estimates similar to the Daubenmire scheme (Mueller-Dombois and Ellenburg 1974).

The design of vegetation sampling in 1982 gave an overview of species present at selected areas within sites. It did not measure the amount of plant foods present during the spring staging period. In 1983, more intensive yet still preliminary sampling was conducted to estimate the form and quantity of aquatic plants that were present. This included below-ground tubers, root systems and shoots within three habitats: exposed shore, shoreline waters (<10 m from shore) and open waters (>10 m from shore). These three habitats corresponded to classifications used during the censuses and behaviour observations. Sampling was conducted from 12 to 19 May 1983, shortly after most of the waterbirds had left the sites.

In estimating the abundance of plants, 5 or 10 replicate samples of substrate were obtained from each of the three habitats at each sampling location. The number of replicates varied with the homogenity of the substrate. Samples were collected from Teslin, Tagish and Marsh sites, however the most extensive sampling took place at Marsh Lake. Samples were collected using an Eckman grab (232 cm^2) which effectively sampled the benthos and exposed shore.

Each sample from the Eckman grab was emptied into a pail, then placed in plastic bags, labelled and frozen until ready for sorting. During sorting each sample was washed through a standard 1.0 mm wire mesh sieve, until all mud was cleared. All live plant material was sorted into shoots, roots, or species groups. Wherever possible, plant pieces were identified to species or species groups; however, in many cases, particularly with below-ground growth, this was impossible. Plant samples were separated according to their classifications, oven dried at 50°C to stable weights (12-18 hours), cooled in a dessicator and weighed to the nearest 0.01 grams. Concurrent with the benthic sampling, cross channel depth profiles at each sampling location were measured.

Aerial Reconnaissance of Open Water Sites

To identify open water areas used by waterfowl in the British Columbia portion of the Yukon River Basin, a low level aerial reconnaissance was flown on 8 May, 1982 and on 28 April 1983. The surveys were conducted by two observers plus a pilot in a single engine Maule aircraft. Survey altitude and speed varied with topography and weather conditions; altitude ranged from 30-60 m and survey speed averaged 145 kph. In 1982 the survey route was designed to check as many potential open water areas as possible in the Yukon River Basin west of Teslin Lake and south of the Yukon/British Columbia border. In 1983 all 1982 sites were resurveyed and in addition, open water sites on the Morley, Swift, Jennings and Teslin Rivers were surveyed.

Each location of open water was recorded with a unique number and plotted on a 1:250,000 scale National Topographic System map. The area of the open water at each site was visually estimated in 1982, but was not estimated in 1983. All birds utilizing the open water areas were identified to species or species group; the data were recorded onto cassette tape and later transcribed onto data forms.

Indices and Presentation

Waterbird abundance and habitat use of the four intensively studied sites (Marsh, Tagish, Teslin and Little Atlin) is presented for species groups and for all individual species observed. Waterbirds were classed into species groups, based on similar taxonomic and ecological affinities. These species groups were dabbling ducks, diving ducks, mergansers, swans, geese and loons and grebes. Analysis at this level investigated broad scale trends in site use by waterbirds. In addition, each species of waterbird and shorebird is presented separately under Species Accounts. For the more common species, data are presented on behavioural activities and habitat use recorded at each site.

As a measure of abundance or volume of waterbird use at each intensive site, an index of waterbird-use days was calculated for each species group (Dennis and Chandler 1974). The index is calculated by taking the mean number of birds observed on each successive pair of surveys (counts), multiplying by the number of days between the two surveys and summing over the entire survey period.

To estimate periods of time when open water sites were important to waterbirds, the cumulative number of days when >5% of the total birds were present (observed on all counts) was calculated for each species group. The index is termed the significant use period (SUP) for each species group.

Statistical tests were performed with NWA STATPAK, version 2.1. The relationship between numbers of waterfowl and the habitat parameters: area of open water, area of exposed mud and area of shallow water (<1m deep) was investigated using forward step-wise multiple regression. Sample points for each site/year regression came from waterfowl counts which preceded and followed the two aerial ice reconnaissance surveys flown in each year. Each sample point consisted of the total number of waterfowl (Y) observed by zone against the area of each habitat variable (X_1-X_3) by zone. Zones 1 and 2 at the Marsh site were excluded. The number of sampling points for each regression was 20, 16, and 16 at Marsh, Tagish and Teslin sites respectively, in both years.

RESULTS

Weather

Spring weather conditions in the southern Yukon Territory were very different between 1982 and 1983. During each year temperatures deviated substantially from the 20 and 30 year average (Figure 6). This led to spring breakup being atypically late in 1982 while breakup in 1983 was earlier than normal.

Mean monthly temperatures from March to May 1982 at Whitehorse and April to May at Johnsons Crossing were lower than normal temperatures by as much as 2.3°C (Figure 6). In contrast the 1983 April and May mean monthly temperatures were respectively 2.5° and 1.3°C warmer than normal, at both weather stations.

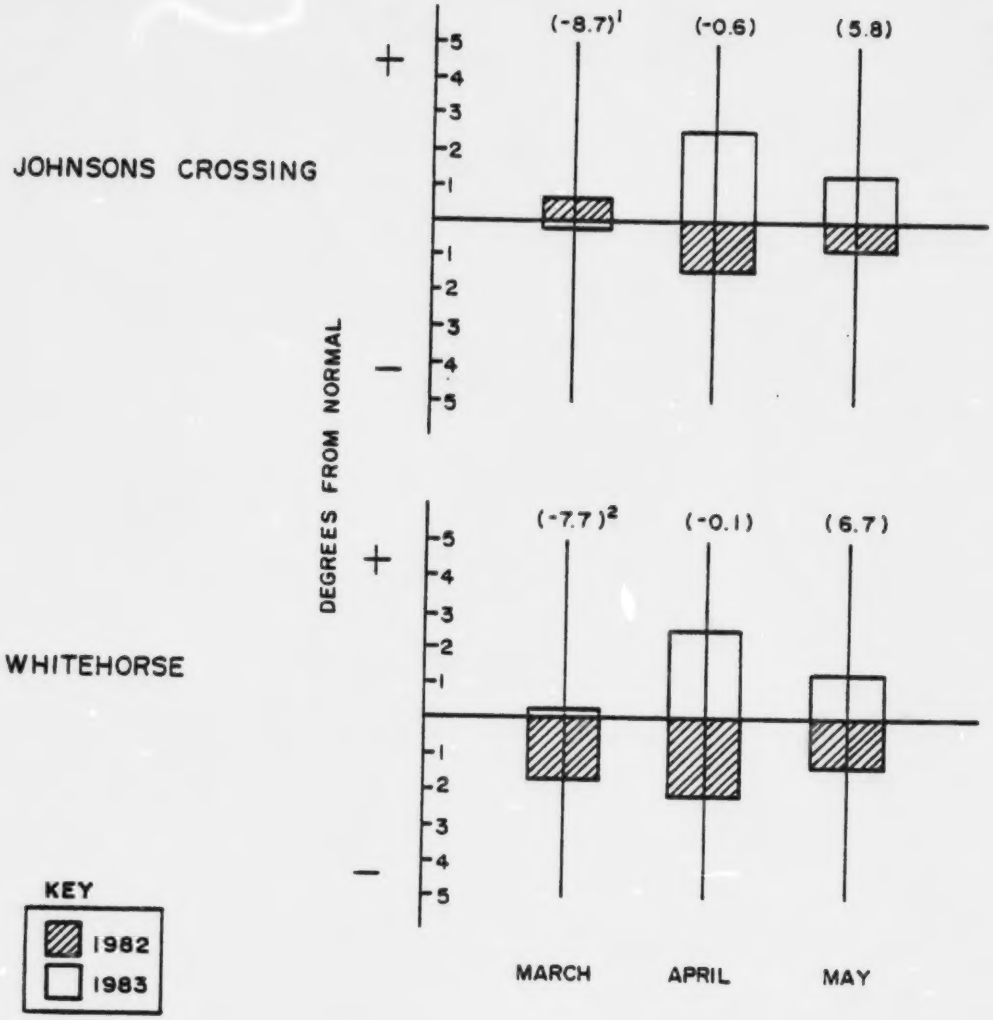
The rate and timing of spring thaw is influenced by the mean daily temperatures. Above 0°C temperatures are favourable for thaw conditions. During 1982, the five-day mean temperatures did not remain above freezing until 23 April, 11 days later than in 1983 (Figure 7). Temperatures also remained much lower throughout May 1982 than in May 1983.

Chronology of Waterbird Abundance

Overview

The arrival of spring migrating waterbirds to the study area was later in 1982 than 1983. In 1982, Trumpeter Swans (the first waterbird arrivals) were not observed until 12 April. At that time, a flock of 12 swans at Tagish were noted by a local resident (Mackenzie pers. comm.), and a flock of 8 swans at Marsh were noted, also by a local resident (Heebink, pers. comm).

In 1983, when the censuses were initiated on 6 April, a total of 400 waterbirds were counted at the three major sites (Marsh, Tagish and Teslin). Prior to the first census, MacKenzie (pers. comm.) had counted 77 Trumpeter Swans on 28 March and 17 Trumpeter Swans on 28



1. 1959-1978 Mean Monthly Temperatures, °C (Atmospheric Environment Service)
2. 1951-1980 Mean Monthly Temperatures, °C (Atmospheric Environment Service)

Figure 6. Deviation of Temperature from Mean Monthly Normal. March - May 1982 and 1983.

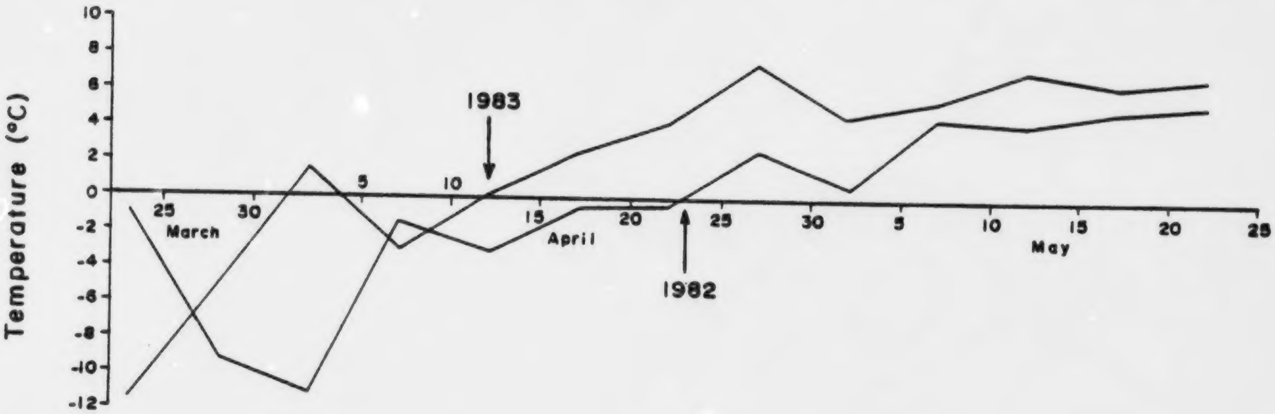


Figure 7 Variation Between Years in the Time Mean Monthly Temperature Remained Above 0°C, 1982 and 1983. Plotted from successive 5 day means.

March, at the Tagish site. On 31 March six swans were counted at Marsh Lake outlet and as many as 130 Trumpeter Swans were noted on 5 April by a local resident (Heebink, pers. comm.). The arrival of swans in the study area by late March was considered unusually early (Mossop, pers. comm.). It was not until 21 April 1982 that the abundance of waterbirds at the three major sites exceeded the initial numbers recorded on 6 April 1983 (Figure 8).

Waterbird abundance reached peak numbers more slowly in 1982 than in 1983. The time between the date of the initial arrival of swans and the date of peak waterbird numbers at the three major sites was 25 days in 1982 and 16 days in 1983. Peak waterbird numbers were recorded on 10 May in 1982, 19 days later than the 1983 peak on 23 April. During both years waterbird abundance decreased rapidly after peak numbers had occurred. Four days after the maximum recorded bird numbers, waterbird abundance had declined by 31% and 39% in 1982 and 1983 respectively.

The duration of waterbird use at the study areas was defined as that period extending from the first arrival of Trumpeter Swans until the last date of census. During 1982 the census period ended before waterbird migration had ceased at the sites, which consequently biased the estimate of the duration of waterbird use in 1982. Despite this bias, the study area was utilizied by waterbirds for a minimum of 39 days in 1982 (12 April - 20 May) and 60 days in 1983 (28 March - 26 May).

Waterbird species group (ducks, swans, geese) composition in the intensive study area varied between years (Figure 8). In 1982, only 4% of the total waterbirds observed during the peak count period were swans, whereas 48% were swans in 1983.

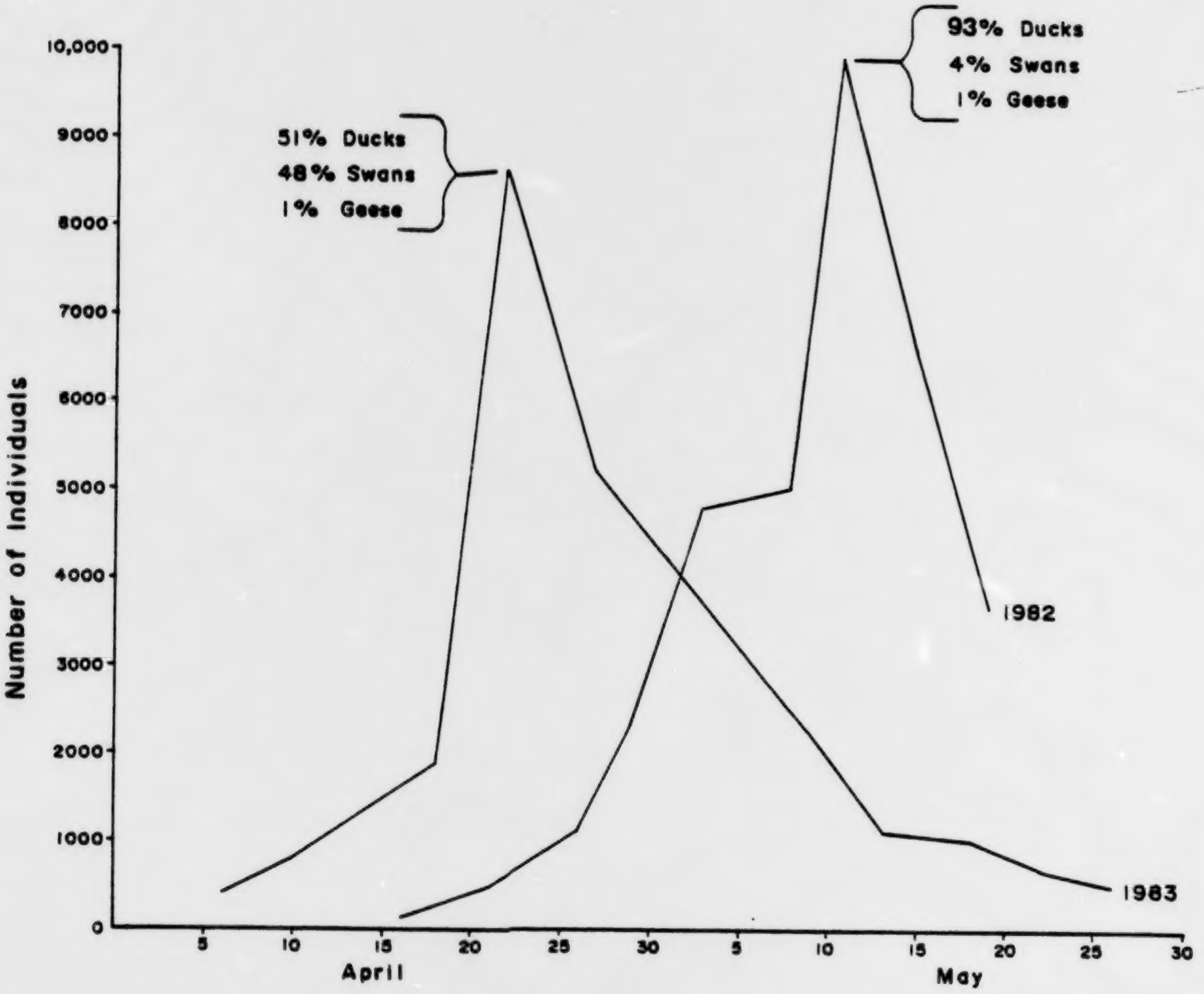


Figure 8 Differences Between Years in the Chronology of Waterbird Migration Through Spring Staging Sites

Dabbling Ducks

In 1983, the peak abundance of dabbling ducks was 20 days earlier than in 1982 at the Marsh, Tagish, Teslin and Little Atlin sites (Figure 9). During 1983, few dabbling ducks were recorded at the sites until a rapid increase in their numbers occurred from 18 April to 22 April, followed by a plateau phase until 5 May and then a slow decline in numbers thereafter. In 1982, dabbling duck abundance slowly increased from 16 April to 12 May, a much longer phase of increase than in 1983; and then began declining rapidly until the end of the census period on 20 May.

Dabbling ducks were present at the staging sites for 32 days in 1982 and 51 days in 1983; however, dabbling duck abundance was still high in 1982 when the census period terminated. In 1982 the significant use period (SUP) occurred between 30 April to 19 May (20 days), while in 1983 the SUP occurred from 19 April to 12 May (24 days).

Diving Ducks

Differences between the two years in the chronology of diving duck abundance followed the same pattern as dabbling ducks (Figure 9). Peak abundance of divers was 19 days earlier in 1983 than in 1982.

Peak migration occurred on 15 May 1982, after numbers had increased slowly from the initial census. In 1983 no substantial increase in migration occurred until 18 to 22 April; thereafter 2 peaks occurred on 26 April and 5 May, followed by a slow steady decline to 26 May.

The SUP was 20 days (30 April - 19 May) in 1982 compared with 27 days (19 April - 5 May) in 1983. However, when the census period terminated in 1982, 20% of the total diving ducks counted, remained at the sites.

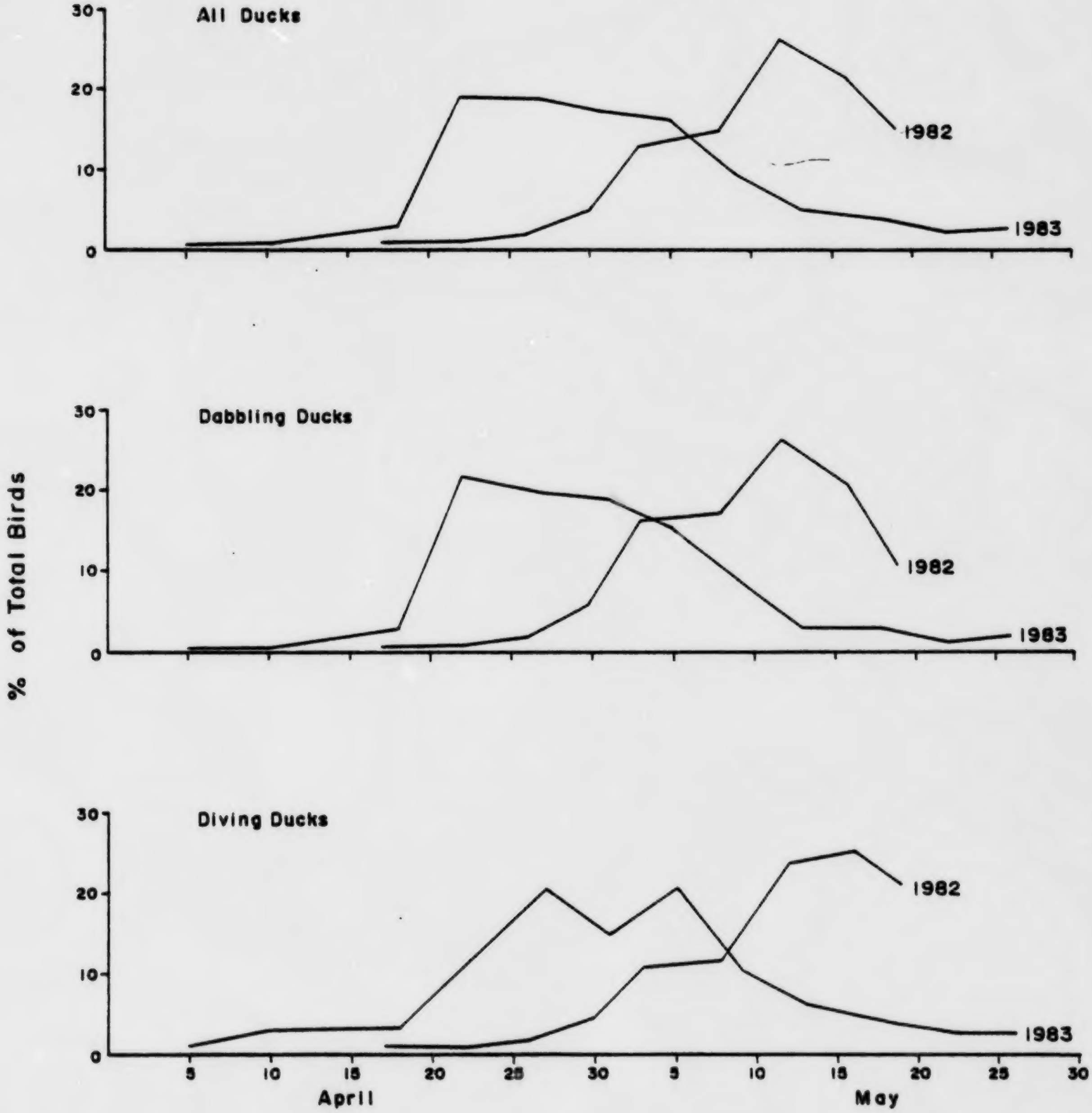


Figure 9 Chronology of Duck Migration Through Spring Staging Sites in 1982 and 1983. Plotted as % of total ducks observed during all counts.

Loons and Grebes

Loons and grebes were late migrants to the study area (Figure 10). In 1982 they were present from 5 to 20 May and in 1983 from 27 April to 26 May. During both years peak loon and grebe abundance occurred eight days after their recorded arrival in the study area. In 1982 over 50% of the total loons and grebes counted occurred on 16 May. In 1983 the greatest period of abundance was from 5 to 13 May; thereafter bird abundance decreased rapidly (Figure 10).

Geese

Goose migration, comprised mostly of Canada Geese, was relatively early compared to other species groups. Arrival in the study areas was in early and mid-April in 1983 and 1982 respectively and peak abundance occurred in April during both years (Figure 10).

Unlike other species groups, little difference occurred between the timing of goose migration in 1982 and 1983. Peak goose abundance was only four days earlier in 1983 than in 1982.

Geese were present at the staging sites from 16 April to 20 May 1982 and 10 April to 26 May 1983. The significant use period in 1982 was at least 39 days (21 April to 19 May) and was 30 days during 1983 (11 April to 10 May).

Swans

The pattern of swan migration was considerably different between the two years. During 1983 swan numbers increased slowly from 5 to 16 April and then rapidly increased to peak abundance (>50% of the cumulative total swans counted) on 22 April. The time of peak swan abundance was only five days later in 1982 (26 April) than in 1983. Two peaks were noted in 1982, yet < 25% of the cumulative total of swans

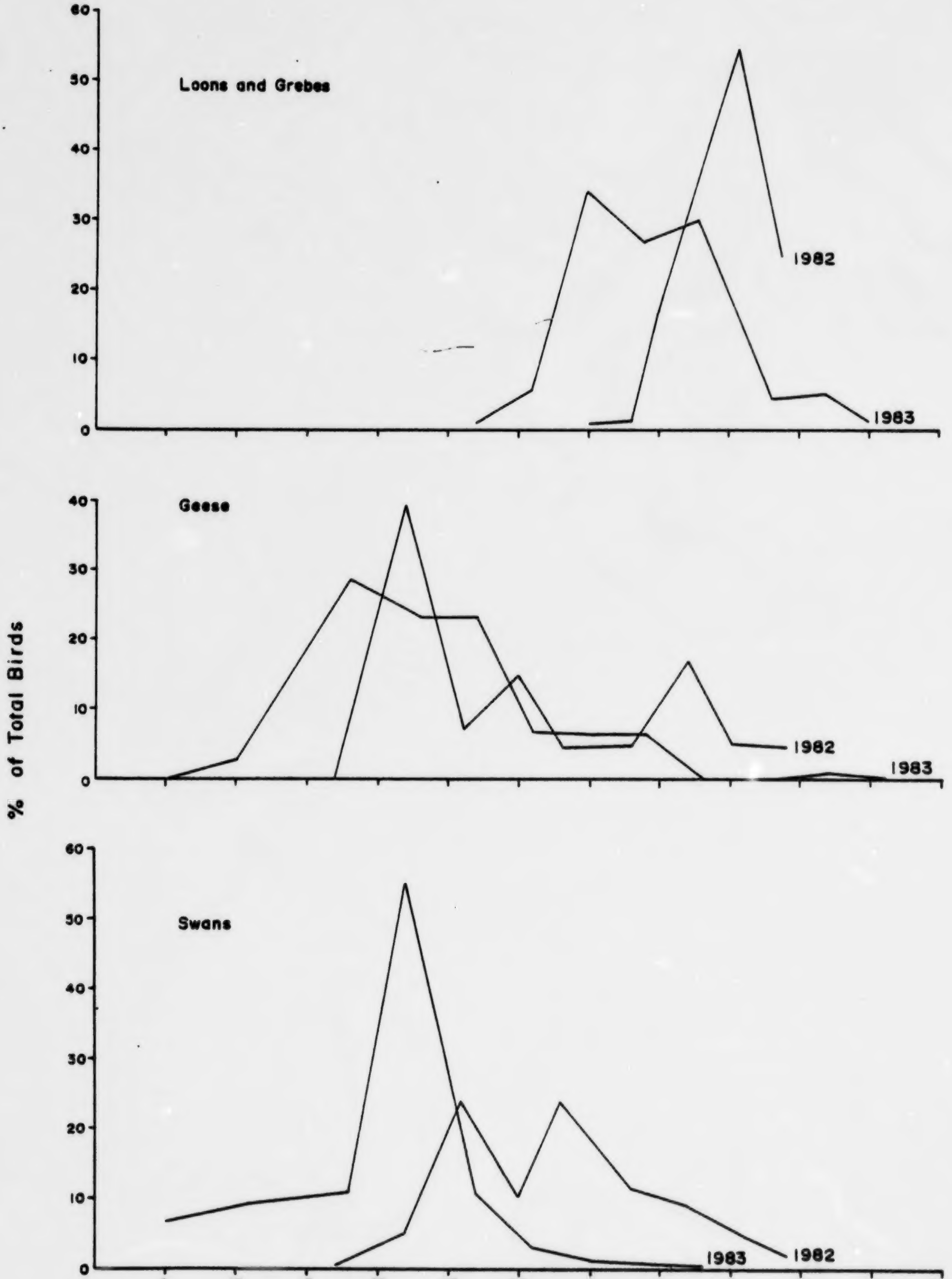


Figure 10 Chronology of Species Group Migration through Spring Staging Sites in 1982 and 1983.

occurred during either peak (Figure 10). The use of the sites by swans during 1983 could best be described as a large pulse of migration compared with two small waves of migration in 1982.

During both years the significant use period of the Marsh, Tagish, Teslin and Little Atlin sites by swans was 25 days although the time of use differed. In 1982 the SUP was 22 April to 16 May while in 1983 the SUP was 5 to 30 April.

Waterbird Abundance - Between Site Comparisons

Species Diversity

Waterbird species diversity, expressed as the total number or richness of species at each site, is presented in Appendices 4 and 5 for 1982 and 1983 respectively. During the two years, a total of 33 different waterbird species was observed. Differences in species diversity between years were attributable to the presence or absence of rare species, rather than changes in the presence of the more common species.

In 1982, a total of 31 species of waterbirds was observed at all four sites. Loons, grebes and swans were represented by two species each, dabbling ducks by eight species and diving ducks (including mergansers) by 13 species. The Tagish site had the highest species diversity (27 species) and Little Atlin the lowest (23 species). Both the Marsh and Teslin sites had diversities of 25 species each. The small, between site differences were caused by the presence/absence of rare species (< 1% of total birds, Appendix 4). During 1982 both species of swans, Trumpeter Swan and Tundra Swan, were observed at all sites, while the rare or less common species, Arctic Loon, American Black Duck, Eurasian Wigeon, Blue-winged Teal, Harlequin Duck, Hooded Merganser and Red-breasted Merganser were absent from at least one to three sites.

During 1983, fewer species (28) were noted than in 1982. Dabbling ducks were represented by eight species, diving ducks by 13 species, geese by three species, swans and grebes by two species each and loon by one species. Between site differences in diversity during 1983 ranged between 23 species at the Teslin site to 26 species at the Marsh site. Species diversity at the Tagish site was 25. At the Little Atlin only three censuses were conducted, causing a low diversity of five species. Differences in diversities between the three major sites in 1983 were also attributable to the presence/absence of rare species. Blue-winged Teal, Cinnamon Teal, Eurasian Wigeon, Oldsquaw, White-winged Scoter and Snow Geese were absent from at least one or two of the three major sites.

When the census commenced on 16 April 1982 there were less than six species at any of the sites. Species diversity steadily increased to a peak richness at the Marsh, Little Atlin and Tagish sites on 15 May (Figure 11). Maximum diversity occurred at Teslin during the last count on 20 May. In 1983 species diversity during the initial count of 5 April was less than five species at any of the three major sites. Diversity generally increased through each count period to a maximum on 3 May at the Marsh site, 13 May at the Tagish site and 9 May at the Teslin site. After 5 May, species diversity at the three sites varied between 13-18 species until 13 May, when diversity began to rapidly decrease at the Teslin site. Diversity at the Marsh and Teslin sites remained high (13-18 species) until counts ceased on 26 May.

In summary, fewer waterbird species occurred in 1983 than in 1982, although the difference was only three species and was attributable to the presence or absence of rare species. The greatest species diversity occurred at the Tagish site in 1982 and at the Marsh site in 1983.

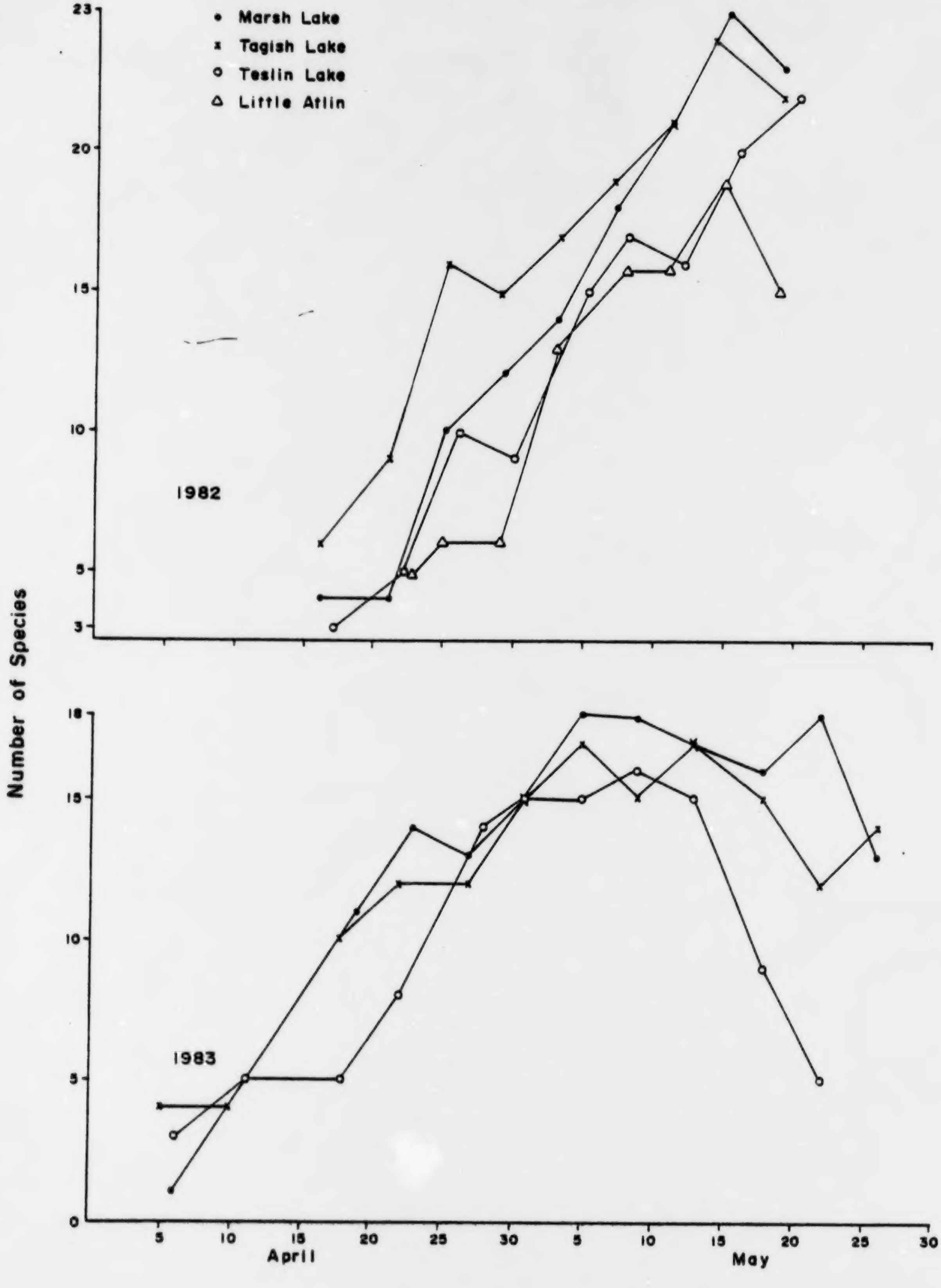


Figure 11 Species Diversity of Waterbirds at the Four Intensive Study Areas. 1982 and 1983

Relative Waterbird Abundance

The relative abundance of species groups in 1982 and 1983 within the intensive study sites is presented in Table 1. As the Little Atlin site was censused just three times in 1983, it is not comparable to the three major sites.

During both years ducks represented at least 73.1% of the total birds counted. Among all sites in 1982 the proportion of total waterbirds which ducks represented, ranged from 82.3-92.2%, at Marsh and Tagish respectively. In 1983 this range was bigger (65.1-84.1%), but the least and greatest representation was again at Marsh and Tagish respectively.

Most of the ducks at the staging sites were dabblers. On average dabbling ducks represented 61% of all ducks in 1982 and 67% in 1983. The predominance of dabblers to divers was common at all sites but Little Atlin. At the Little Atlin site, in 1982, diving ducks represented as much as 57% of the total ducks counted.

Swans were more abundant in 1983 and represented 24.5% (range 14.2-31.9%) of the total birds counted at all sites. In contrast, swans represented only 8.2% (range 2.7-15.1%) of the total waterbirds in 1982. During both years, the greatest proportion of swans, relative to other birds at the site, was at the Marsh site.

Geese, mergansers, and loons and grebes each represented <5% of the total waterbirds in 1982 and 1983. Similarly, each group at each individual site (except Little Atlin) represented <5% of the waterbirds. At the Little Atlin site geese represented 8.5% of the waterbirds. This was the greatest proportional representation of geese at any of the sites.

In both years, dabbling duck species were the most abundant waterbird species. The most common species (in order of abundance) were: Green-winged Teal, American Wigeon, Mallard and Northern Pintail in 1982 (Appendix 4); and in 1983 were; Northern Pintail, American Wigeon, Mallard and Green-winged Teal (Appendix 5).

TABLE 1 Relative Abundance of Species Groups at Each Site, 1982 and 1983.

	% OF TOTAL BIRDS 1982				
	MARSH	TAGISH	TESLIN	LITTLE ATLIN	$\bar{x}$
Dabbling Ducks	55.5	57.8	66.4	32.4	53.0
Diving Ducks	25.4	32.3	19.3	49.6	31.7
Mergansers	1.1	1.9	0.5	1.3	1.2
Total Ducks*	82.3	92.2	86.1	86.3	86.7
Swans	15.1	3.8	10.3	2.7	8.0
Geese	1.1	1.5	2.0	8.5	3.3
Loons & Grebes	1.5	2.5	1.5	2.5	2.0

	% OF TOTAL BIRDS 1983			
	MARSH	TAGISH	TESLIN	$\bar{x}$
Dabbling Ducks	42.1	56.6	51.6	50.1
Diving Ducks	20.5	20.6	15.6	18.9
Mergansers	0.7	1.4	0.3	0.8
Total Ducks*	65.1	83.1	71.0	73.1
Swans	31.9	14.2	27.4	24.5
Geese	2.5	0.8	0.3	1.2
Loons & Grebes	0.5	1.9	1.3	1.2

* Includes Dabbling, Diving and Unidentified Ducks and Mergansers

Scaup spp. were the more abundant species of diving ducks during the two study years. Waterbird species presence and abundance in 1982, was similar between the three major sites, yet differed from the Little Atlin site where Barrow's Goldeneye, Bufflehead and Canada Geese each represented approximately 10% of the total waterbirds.

Paired t-tests of total bird numbers (count data as pairs) were conducted to test for differences in species group abundance between sites. In 1982, the abundance of waterbirds at the Little Atlin site differed significantly from the other sites. However, the abundance of diving ducks between Teslin and Little Atlin was not significantly different (Table 2). Generally, waterbird abundance did not differ between the three major sites, in 1982. However, swans were most abundant at the Marsh site, differing significantly from abundance at the Tagish site but not significantly from swan abundance at the Teslin site. Diving duck abundance was higher at the Tagish site than at the Teslin site, but was comparable between the Marsh and Tagish sites.

In 1983, the Marsh site had significantly more total waterbirds than found at the Tagish or Teslin sites (Table 2). Swans were not significantly more abundant at the Marsh site than at the Tagish site but were more abundant at Marsh than Teslin, in 1983. There was no significant difference in the abundance of any species groups between the Tagish and Teslin sites, in 1983.

As another comparison of waterbird abundance, the total number of waterbird-use days was calculated at each of the study sites. The greatest number of waterbird-use days occurred at the Tagish site in 1982 (Table 3) and at the Marsh site in 1983 (Table 4). At both of these sites, the number of waterbird-use days was > 60,000 days. The number of waterbird-use days at the Teslin site was approximately 50%

TABLE 2 Paired Comparisons of the Species Groups Occurring at Each Site, 1983 and 1982. Values are calculated t-values for two-sided paired t-tests using count data as pairs.

	df	Marsh vs Tagish	Tagish vs Teslin	Marsh vs Teslin	Marsh vs Little Atlin	Tagish vs Little Atlin	Teslin vs Little Atlin
1983							
Total Waterbirds	10	2.83*	2.31*	5.53*	NC	NC	NC
Dabbling Ducks	10	0.54	1.63	3.73*	NC	NC	NC
Diving Ducks	10	1.39	2.20	4.17*	NC	NC	NC
Swans	8	2.01	0.28	3.30*	NC	NC	NC
1982							
Total Waterbirds	8	-1.15	2.07	1.95	3.86*	2.65*	3.43*
Dabbling Ducks	8	-1.02	1.93	0.94	3.10*	2.59*	3.06*
Diving Ducks	8	-1.46	2.49*	2.07	3.00*	2.47*	0.89
Swans	8	3.41*	-1.52	1.23	3.06*	NC	2.56*

* significant at P=.05

NC not compared

TABLE 3 Waterbird-Use Days Measured at Each Site in 1982.

	MARSH	TAGISH	TESLIN	LITTLE ATLIN
Dabbling Ducks	22,619	35,498	20,259	3,170
Diving Ducks	9,954	19,183	5,605	4.105
Mergansers	403	1,163	128	139
Total Ducks*	33,124	55,894	26,000	7,742
Swans	5,950	1,627	3,318	218
Geese	521	1,059	49	878
Loons & Grebes	608	1,553	532	181
TOTAL	40,203	60,133	29,899	9,019

* includes Dabbling, Diving and Unidentified Ducks and Mergansers

TABLE 4 Waterbird-Use Days Measured at Each Site in 1983.

	MARSH	TAGISH	TESLIN
Dabbling Ducks	25,891	23,270	13,539
Diving Ducks	13,120	8,173	4,188
Mergansers	385	608	86
Total Ducks*	40,459	34,537	18,723
Swans	21,728	6,439	7,865
Geese	1,926	336	101
Loons & Grebes	316	567	346
TOTAL	64,429	41,879	27.035

* includes Dabbling, Diving and Unidentified Ducks and Mergansers

less than the maximum recorded in 1982 and 1983 at Tagish and Marsh. In 1982, the Little Atlin site had < 10,000 waterbird-use days.

In both years, dabbling ducks represented the greatest number of use days at all sites, other than at the Little Atlin site (in 1982) where diving ducks were most abundant. Swans comprised only 15% of the total waterbird-use days at the Marsh site in 1982 yet over 30% of the total in 1983. In 1982, a total of 10,895 swan-use days occurred at the three major sites versus 36,032 swan-use days in 1983. Unfortunately, no other species group could be compared between the two years because the census period did not cover the entire migration period of any other species group.

Within Site Distribution of Waterbirds

The distribution of waterbirds within each site in the different zones (lake outlet, lake inlet, river) was based on the percent of the total waterbirds counted during the entire census period. The use of specific site zones by waterbirds changed as zone conditions changed during spring thaw. Therefore, by using the percent of total birds over all the count periods to determine bird zone use, the average use of the zones during the spring staging period is presented.

Marsh Site

The Marsh Lake site was divided into seven zones: one lake outlet and six river zones (Figure 4). In both study years, over 70% of all waterbirds occurred in zone 7, Marsh Lake outlet. Zone 3, a river section, also received substantial waterbird use with respect to other river zones (Table 5). Very few waterbirds used zones 1 and 2, which happened to be the smallest zone and adjacent to the NCPC control dam and the Alaska Highway.

TABLE 5 Distribution of Waterbird Species Groups Within Zones of the Marsh Lake Staging Site, Spring 1982 and 1983. Values are % of the total (n) observed during the study.

	1982 ZONE							
	1	2	3	4	5	6	7	n
Dabbling Ducks	0.1	0.3	13.8	3.4	7.8	3.8	70.8	(6293)
Diving Ducks	0.4	0.4	12.2	2.6	11.2	12.3	60.9	(2889)
Mergansers	0	1.7	32.7	2.5	18.5	20.2	24.4	(119)
All Ducks*	0.2	0.4	13.5	3.5	8.9	6.6	66.9	(9334)
Swans	0	0	2.6	4.7	2.3	1.0	89.4	(1713)
Geese	0	0	0	39.7	1.6	19.0	39.7	(126)
Loons & Grebes	0	0	14.8	0	1.8	6.5	76.9	(169)
Total Waterbirds	0.2	0.3	11.7	4.0	7.7	5.9	70.2	(11342)
	1983 ZONE							
	1	2	3	4	5	6	7	n
Dabbling Ducks	0.3	0.2	14.4	1.1	5.0	0.7	78.3	(6437)
Diving Ducks	2.4	0.5	18.0	2.9	11.8	7.2	57.2	(3018)
Mergansers	2.8	0	78.0	0	11.8	3.7	3.7	(109)
All Ducks*	1.0	0.3	16.1	2.8	7.4	2.7	69.7	(9833)
Swans	0	0	6.0	0.1	10.5	0.5	82.9	(4789)
Geese	0	0	6.6	0	0.5	1.1	91.8	(379)
Loons & Grebes	0	0	77.7	2.0	8.1	0	12.2	(49)
Total Waterbirds	0.6	0.2	12.9	1.9	8.2	2.0	74.2	(15050)

* Includes Dabbling, Diving and Unidentified Ducks and Mergansers

With the exception of geese and mergansers, over 60% of all species groups occurred in zone 7 in 1982. In both years, over 80% of the swans occurred in zone 7. Mergansers predominantly used zones 3, 5, 6 and 7 and geese used zones 4 and 7.

Tagish Site

This site was divided into four zones: one lake outlet, one lake inlet and two river zones (Figure 5). Most waterbirds at the Tagish site were in zone 1, Marsh Lake inlet (Table 6). Less than 5% of the total waterbirds used zone 4 (Tagish Lake outlet) during both years. Only mergansers, used zones 1, 2 and 3 in relatively the same proportions, and this only occurred during 1982. In 1983, the abundance of waterbirds in zone 1 and the scarcity of birds in zone 4 was similar to patterns in 1982.

Teslin Site

The Teslin site was divided into four zones: three river zones and a lake outlet (Figure 3). Waterbird abundance among the zones varied between the two years (Table 7). The greatest proportion (32.9%) of total waterbirds in 1982 was in zone 2. In 1983, zone 4, the lake outlet had the greatest proportion (52.5%) of the waterbirds. These between year differences can be attributed to changes in abundance of species groups and changes in the pattern of use of zones by specific groups.

In 1983, 91.8% of the swans were noted in zone 4. During both years, dabbling ducks were well represented at all zones. Diving ducks were predominant at zone 4, where more than 50% occurred each year.

Zone 3 was the least used zone during each year. However, geese were most abundant in this zone in both years. Zone 1 was not used by swans, geese, or loons and grebes in 1983.

TABLE 6 Distribution of Waterbird Species Groups Within Zones of Tagish Lake Staging Site, Spring 1982 and 1983. Values are % of the total (n) observed during the study.

	1982				
	ZONE				
	1	2	3	4	n
Dabbling Ducks	62.1	30.0	7.2	0.7	(8579)
Diving Ducks	77.2	14.7	6.8	1.3	(4892)
Mergansers	31.9	25.4	29.8	12.9	(235)
All Ducks*	67.0	24.5	7.4	1.1	(13731)
Swans	73.3	15.1	9.6	2.0	(636)
Geese	58.7	27.4	13.9	0	(230)
Loons & Grebes	95.8	2.7	1.5	0	(407)
Total Waterbirds	67.9	23.5	7.5	1.1	(15004)

	1983				
	ZONE				
	1	2	3	4	n
Dabbling Ducks	71.7	18.3	7.6	2.4	(5671)
Diving Ducks	72.5	21.7	5.1	0.7	(1905)
Mergansers	52.9	34.8	12.3	0	(138)
All Ducks*	72.7	18.1	6.7	2.5	(8276)
Swans	77.5	15.5	0	7.0	(1420)
Geese	81.4	18.6	0	0	(70)
Loons & Grebes	85.4	14.6	0	0	(137)
Total Waterbirds	73.7	17.7	5.6	3.0	(9903)

* Includes Dabbling, Diving and Unidentified Ducks and Mergansers

TABLE 7 Distribution of Waterbird Species Groups Within Zones of Teslin Lake Staging Site. Spring 1982 and 1983. Values are % of the total (n) observed during the study.

	1982 ZONE				
	1	2	3	4	n
Dabbling Ducks	29.3	34.6	16.2	19.9	(5325)
Diving Ducks	12.1	25.1	9.6	53.2	(1508)
Mergansers	0	27.5	27.5	45.0	(40)
All Ducks*	25.4	32.8	14.6	27.4	(6876)
Swans	2.2	38.7	26.6	32.5	(873)
Geese	13.3	6.7	73.3	6.7	(15)
Loons & Grebes	9.4	4.3	7.7	78.6	(117)
Total Waterbirds	22.5	32.9	15.9	28.7	(7881)

	1983 ZONE				
	1	2	3	4	n
Dabbling Ducks	25.4	28.8	19.7	26.1	(3223)
Diving Ducks	9.2	12.3	12.2	66.3	(1637)
Mergansers	9.5	38.1	38.1	14.3	(21)
All Ducks*	20.8	22.3	17.1	39.8	(5097)
Swans	0	6.8	1.3	91.9	(1639)
Geese	0	5.3	63.1	31.6	(19)
Loons & Grebes	0	11.4	15.0	73.6	(88)
Total Waterbirds	15.5	18.4	13.6	52.5	(6843)

* Includes Dabbling, Diving and Unidentified Ducks and Mergansers

Waterfowl Use at Other Open Water Sites

Locations and Distribution of Open Water Sites

Aerial surveys were flown on dates which roughly coincided with peak waterbird migration. In 1982 the survey occurred three days prior to peak waterfowl migration, and in 1983 occurred six days after peak migration. The locations of early open water areas plotted on Figure 12 correspond to respective site numbers in Appendix 6 and 7 which give descriptions and numbers of waterfowl observed at each site during 1982 and 1983 respectively.

Open water areas were classified into five types based on site morphology: river outlets - open water where rivers empty into lakes; river inlets - open water where lakes empty into rivers; river sections - open waters of river channels; lake leads - open water areas within lakes at narrows, adjacent to islands or channels joining small lakes together; and riparian shallow sloughs - areas of open water along the periphery of sloughs adjacent and joined to rivers via streams or channels. No riparian shallow sloughs had open water during the survey of 1982.

During the 1982 survey, 56 open water areas were identified along the 790 km flight line (Table 8). These sites ranged in area of open water from <0.1 ha to 150 ha ($\bar{x}$=10.0 ha). Eighty-two percent of the sites had 10 ha or less of open water. Most of the sites (41%) and correspondingly most of the area of open water (45%) were river outlets. River inlets and river channels each represented 16% of the total open water sites. Although lake channels represented only 27% of the sites, they accounted for 34% of the open water available. Thus among the open water sites in 1982, river outlets and lake channels accounted for 80% of the available open water area and 68% of the total sites with open water.

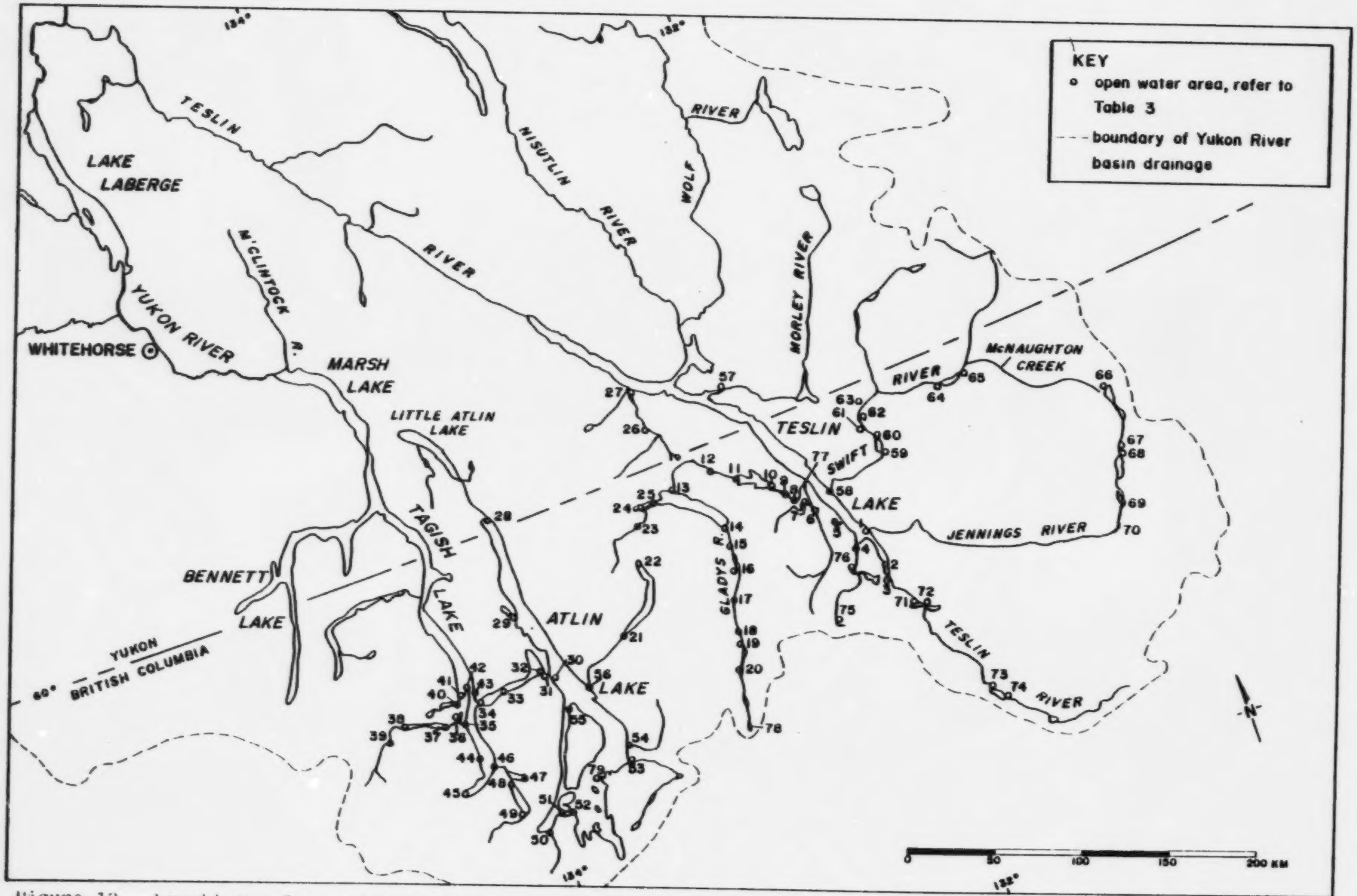

KEY
o open water area, refer to Table 3
- - - boundary of Yukon River basin drainage
LAKE LABERGE
TESLIN
RIVER
NISUTLIN RIVER
WOLF RIVER
MORLEY RIVER
McNAUGHTON CREEK
RIVER
WHITEHORSE
YUKON RIVER
M'CLINTOCK R.
MARSH LAKE
LITTLE ATLIN LAKE
TAGISH LAKE
BENNETT LAKE
ATLIN LAKE
GLADYS R.
TESLIN
SWIFT
LAKE
JENNINGS RIVER
TESLIN RIVER
YUKON
BRITISH COLUMBIA
60°
134°
132°
N
0
50
100
150
200 KM

Figure 12 Locations of Open Water Areas Found During Aerial Surveys, 8 May 1982 and 28 April 1983

TABLE 8 Distribution of Waterfowl by Open Water Type, Surveyed During Aerial Reconnaissance. Northern B.C., 8 May 1982.

OPEN WATER TYPE	NUMBER	ESTIMATED AREA (Ha)	TOTAL				PERCENT				BIRDS/Ha
			DUCKS	GEESE	SWANS	TOTAL	DUCKS	GEESE	SWANS	TOTAL	
River Outlet	23	189	975	8	44	1,027	35	12	75	36	5.4
River Inlet	9	24	658	0	0	658	24	0	0	23	27.4
River Channel	9	61	237	9	0	246	9	14	0	8	4.0
Lake Channel	15	144	880	49	15	944	32	74	25	33	6.6
TOTAL	56	418	2,750	66	59	2,875	100	100	100	100	6.9

In 1983 river outlets represented the greatest percent of the total sites (39%), followed by lake channels (23%), river sections (13%), river inlets (17%) and shallow sloughs (8%) (Table 9). Large areas of mudflats were exposed at some of the larger sites in 1983, particularly the mouths of the Swift (#58) and Jennings (#1) Rivers and along the shores of Teslin Lake channel (#2). No exposed mudflats were noted in the 1982 survey, and this was likely a function of the late timing of spring breakup. All of the sites noted with exposed mudflats in 1983 had extensive cratering on the mudflats, which were likely caused by swan and goose feeding activity during the fall.

The distribution of waterfowl by rivers surveyed is presented in Tables 10 and 11, for 1982 and 1983 respectively. Comparing only those rivers which were surveyed in both years, more open water was available and more birds were present in 1983 than in 1982.

Waterfowl Distribution and Abundance

In 1982 only three sites had concentrations of over 200 birds. These three sites: Jennings River (#1), Teslin Channel (#2), and Fish Lake (#25), also contained high concentrations of birds in 1983 (Appendix 7). In addition, Teslin River outlet (#3), Swift River outlet (#58), large slough #1 on the Swift River (#62), and Gladys River (#25), all contained substantial numbers of waterfowl in 1983. The largest concentration of waterfowl (1,373 birds) occurred on the upper Teslin River between Hutsigola Lake (#71) and Hyland Lake (#72). All of the open water sites with large waterfowl concentrations (>200 birds) were situated within the Teslin Lake and Teslin River drainage. Concentrations of waterfowl on open water areas of Atlin and Tagish Lakes in 1983 occurred at Torres Channel (#55), Atlin River outlet

TABLE 9 Distribution of Waterfowl by Open Water Type, Surveyed During Aerial Reconnaissance,Northern B.C., 28 April 1983.

		TOTAL				PERCENT			
	NUMBER	DUCKS	GEESE	SWANS	TOTAL	DUCKS	GEESE	SWANS	TOTAL
River Outlet	31	2,200	83	5	2,288	37	20	9	36
River Inlet	14	667	47	37	751	11	11	70	12
River Section	10	1,019	161	0	1,180	18	40	0	18
Lake Channel	18	1,210	112	11	1 333	39	26	21	21
Shallow Sloughs	6	810	12	0	822	14	3	0	13
TOTAL	79	5,906	415	53	6 374	100	100	100	100

TABLE 10 Distribution of Waterfowl by Rivers Surveyed During Aerial Reconnaissance, Northern B.C., 8 May 1982.

	LENGTH (km)	% OPEN WATER	TOTAL			DENSITY (birds/km)		
			DUCKS	GEESE	TOTAL	DUCKS	GEESE	TOTAL
Gladys River	133	99	502	12	514	3.9	0.1	3.9
Pine Creek	45	50	65	0	65	1.4	0	1.4
Wann River	22	1	102	0	102	4.6	0	4.6
TOTAL	200	$\bar{x}$= 50	669	12	681	3.3	0.1	3.4

TABLE 11 Distribution of Waterfowl by Rivers Surveyed During Aerial Reconnaissance, Northern B.C., 28 April 1983.

			TOTAL WATERFOWL				DENSITY (birds/km)			
	Length (km)	% Open Water	Ducks	Geese	Swans	Total	Ducks	Geese	Swans	Total
Swift River	88	50	1,293	21	13	1,327	14.7	0.2	0.1	15.1
McNaughton Creek	52	30	0	0	0	0	0	0	0	0
Jennings River	126	30	250	30	4	284	2.0	0.2	<0.1	2.2
Teslin River	53	50	707	226	0	933	13.3	4.3	0	17.6
Hayes River	24	80	315	0	5	320	13.1	0	0.2	13.3
Gladys River	133	70	801	27	50	878	6.0	0.2	0.4	6.6
Pike River	18	1	65	0	0	65	3.6	0	0	3.6
Pine Creek	45	100	21	0	0	21	0.5	0	0	0.5
Wann River	22	1	37	0	0	37	1.7	0	0	1.7
TOTAL	561	$\bar{x}$= 46	3,489	304	72	3,865	6.2	0.5	0.1	6.9

(#30), and Atlin River inlet (#55). Only one site (#32) in 1982, in the Atlin and Tagish Lakes area contained more than 100 waterfowl. A linear regression showed a correlation between the number of birds to the area of open water ($r = 0.796$). The slope of the line was significant ($t = 11.79$, 54 df, $P < 0.001$).

In 1983, the Swift River, from its mouth at Teslin Lake to its junction with the McNaughton River, contained the highest absolute number of waterfowl (1,327 birds). However, this represented only the second highest waterfowl density (15.1 birds/km) during the survey. High waterfowl densities were recorded on the Teslin River (17.6 birds/km) and on the Hayes River (13.3 birds/km). Over all river systems surveyed in 1983, waterfowl densities averaged 7.6 birds/km (Table 11). In 1982 waterfowl density averaged 3.1 birds/km ranging from 1.4 birds/km on the Gladys River (where waterfowl were most abundant), to 4.6 birds/km on the Wann River (Table 10).

In 1982 river outlets were the most common type of open water sites and collectively supported the greatest waterfowl abundance (Table 8). Lake channels were the second most common open water type and correspondingly had the second highest abundance of waterfowl. On the basis of bird numbers per unit area, river inlets supported the highest density of waterfowl (27.4 birds/ha open water), which was substantially higher than densities at any of the three other site types (Table 8).

The greatest proportion of waterfowl (36%) were noted at river outlets in 1983. However, substantially fewer waterfowl were noted at river inlets (12% versus 23%) and lake channels (21% versus 33%). More waterfowl were noted along river sections (18% versus 8%) in 1983 than in 1982.

Waterfowl Species Group Composition

During the aerial surveys of both years, over 90% of all waterfowl observed were ducks. Species group composition in 1982 was 96%, 2% and 2% ducks, geese and swans, respectively. The 1983 species group composition was 92%, 7% and 1% ducks, geese and swans, respectively. Not all ducks were differentiated to divers and dabblers, however, from those that were identified, dabbling and diving ducks represented 56% and 40% in 1982 and 60% and 40% in 1983. All geese observed were Canada Geese while swans may have been either species, Tundra or Trumpeter.

Canada Geese

Geese were most abundant during the 1983 aerial reconaissance due to the inclusion of the upper Teslin River in the 1983 survey, where 74% of the total geese were counted. A large concentration of Canada Geese (156 birds) occurred on the Teslin River channel between Husigola lake (#77) and Hyland Lake (#72). Other large concentrations of geese associated with the Teslin River occurred at the river outlet (#3), and Teslin Lake narrows (#2). Geese were also noted on the Swift, Jennings and Gladys rivers. In 1982, 58% of the geese were noted on Teslin Lake channel (#2), and Fish Lake (#25). Goose density on rivers averaged 0.5 and 0.1 geese/km in 1983 and 1982 respectively, with the highest individual density (4.3 geese/km) recorded on the Teslin river (Table 11).

Swans

Few swans were noted during the surveys in either year (Table 8 and 9). In 1982, 75% of the 59 swans recorded were on river outlets, and the other 25% were on lake channels. The largest concentrations occurred at the Jennings River outlet (#1), and Fish Lake channel (#25). In 1983, swans were noted on river inlets (61%), river outlets (21%) and lake channels (18%). The largest groups of swans were noted at Hull Lake inlet (#11), and Fish Lake channel (#25).

Biophysical Habitat

Physical Habitat

The Marsh site was characterized by a large area of open water of which approximately 50% was shallow water (< 1 m deep), (Table 12). The length of shore/water interface was greatest at the Marsh site among the four sites and was a function of 11 km of river within the study area (zones 1-6). Mudflats became exposed with receding ice cover and/or lowered water levels as spring progressed. The Marsh site had less area of mudflats than Teslin, yet a similar area to Tagish.

The Tagish site shared a similarly large area of open water with the Marsh site yet diverged with respect to the area of shallow water. Only 15% of the area of open water at Tagish was shallow water (Table 12). The length of shore/water interface was less than the Marsh site, yet comparable with the Teslin site. Exposed mudflats were most apparent during the May surveys, and especially in May of 1983.

The Teslin site had less total area of open water than the Marsh or Tagish sites. Approximately 28% and 58% (in 1982 and 1983 respectively) of the open water area was shallow water. The Teslin site had the largest area of exposed mudflats among the four sites. Although mudflats were found along the shores of the Teslin River, most of the area of mudflats was at the lake outlet (zone 4). The amount of shore-edge available was comparable to the Tagish site.

TABLE 12 Abundance of Physical Habitat Types Occurring in Each of the Intensive Study Sites.

	MARSH		TAGISH		TESLIN		LITTLE ATLIN	
DATE OF SURVEY 1982	22-4	9-5	22-4	9-5	22-4	9-5	22-4	9-5
Total Open Water (ha)	516	600	530	623	107	214	3	14
Shallow Water (ha)	258	287	77	87	29	63	-	-
Exposed Mudflat (ha)	0	11	1	12	0	103	0	6
Shore/Water Interface (km)	0	31.8	1.1	18.8	0	12.8	0	1.2
Ice/Water Interface (km)	35.6	4.8	23.3	11.6	15.4	5.5	2.3	1.8

	MARSH		TAGISH		TESLIN	
DATE OF SURVEY 1983	26-4	11-5	26-4	11-5	26-4	11-5
Total Open Water (ha)	529	769	529	791	186	535
Shallow Water (ha)	287	360	93	123	102	324
Exposed Mudflat (ha)	10	73	5	110	15	333
Shore/Water Interface (km)	30.1	42.3	15.0	23.0	8.6	19.7
Ice/Water Interface (km)	5.7	1.1	10.6	10.0	9.3	0

Physical habitat data was only available for 1982 at the Little Atlin site (Table 12). This site had obviously less open water than any of the three major sites. The maximum area recorded was 14 ha on May 9. Relative to the area of open water, the Little Atlin site had a high ratio of water area to ice/water interface (1:0.8 and 1:0.1). The most shore-edge available was 1.2 km on May 9. No mudflats were ever available at the site. Little Atlin Lake outlet (zones 2-4) was characterized by stands of emergent vegetation, which in the spring represented the former year's growth of Equisetum spp.

In comparing the amount of physical habitats available at a given site between 1982 and 1983, it was apparent that spring conditions in 1982 were temporarily behind 1983 conditions and that the rate of change in habitat conditions from late April to mid-May varied between years. When the spring staging studies were initiated (16 April 1982 and 5 April 1983) all of the lake outlets and rivers at all sites, and the lake inlet at Tagish site were open. The area of open water measured in late April showed little difference between the years, at any of the three major sites (Table 12).

There were however, differences in the late April measurements between the ice/water interface measurements from year to year, the shore/water interface and the area of exposed mudflat. During the study of 1982, exposed mudflats were not observed until early May. During 1983, shore edge was obvious at the Teslin site by 11 April and at the Marsh and Tagish sites by 15 and 16 April. By the time of the first ice cover survey in 1983, mudflats were exposed (30 ha) while only an area of 1 ha of mudflat was exposed in 1982, four days earlier (Table 12). Lake ice was still land fast at the three sites on 9 May 1982. However, in 1983 on 11 May, both Teslin and Tagish Lakes were breaking-up and large ice pans were floating down the lakes and rivers.

During 1983 the rate of change in the amounts of open water, shallow water and exposed mudflat was greater than in 1982 and the rate of change of the amount of shore/water interface and ice/water interface was less than during the previous year (Table 13). Although open water areas were similar in late April between years, during 1983 more water became ice-free sooner than in 1982. By late April in 1983 much of the shore-edge was already exposed, unlike 1982 conditions in which only 1.1 km of shore-edge were exposed.

Marsh Site

At the Marsh site, the lake outlet (zone 7) represented > 50% and as much as 75% of the total area of open water. The Yukon River is usually open by early April, contributing to the large area of open water available in the spring. The Marsh site had a large area of shallow water available in the spring. Much of the shallow water was at zone 7, where most of M'Clintock Bay is < 1 m deep (Table 14). Zone 7 was the largest of the Marsh site zones and offered all of the five habitat types, which were well represented relative to habitat availability in the other zones. The M'Clintock River mouth forms a delta area in zone 7, making this zone unique among lake outlets. Depth profiles of the Marsh Lake outlet were conducted across the shallow waters and in two different areas across the lake channel (Figure 13 and 14). The south side of the lake had a steep depth gradient with little area of water < 1 m deep. The lake channel had a maximum depth of 6 m in late May.

Depth profiles across the Yukon River at zones 5 and 3 revealed that there was little area where the water was < 1 m deep (Figure 15). Maximum channel depths were 6.6 m in Zone 5 and 5.6 m on the transect in Zone 3. Although the Yukon River in Zone 3 does not provide much shallow water, much of Zone 3 is bays and ponds with shallow areas < 1 m deep, as well as exposed mudflats (Table 14). These areas became available in May. In 1982, few of the ponds became ice-free during the course of the study. In 1983, the entire area was ice-free by mid-May.

TABLE 13 Changes in Available Amount of Physical Habitat Types Between April and May at Each Intensive Study Site, Spring 1982 and 1983.

	MARSH		TAGISH		TESLIN	
	1982	1983	1982	1983	1982	1983
Total Open Water (ha)	84	240	93	262	107	349
Shallow Water (ha)	30	73	10	30	34	222
Exposed Mudflat (ha)	11	63	11	105	103	318
Shore/Water Interface (km)	31.8	12.2	17.7	8.0	12.8	11.1
Ice/Water Interface (km)	-30.8	-4.6	-11.7	-0.6	-9.9	-9.3

TABLE 14 Marsh Lake Outlet - Distribution and Amount of Physical Habitat Types Among the Seven Zones, Spring 1982 and 1983.

	ZONE															
	1		2		3		4		5		6		7		Total	
DATE OF SURVEY 1982	22-4	9-5	22-4	9-5	22-4	9-5	22-4	9-5	22-4	9-5	22-4	9-5	22-4	9-5	22-4	9-5
HABITAT																
Total Open Water (ha)	5	5	6	5	43	42	57	60	68	66	36	32	301	390	516	600
Shallow Water (ha)*	1	1	1	1	14	14	9	9	11	11	7	7	215	244	258	287
Exposed Mudflat (ha)	0	1	0	1	0	<1	0	<1	0	<1	0	1	0	8	0	11
Shore/Water Interface (km)	0	.8	0	.9	0	4.6	0	4.1	0	9.7	0	5.6	0	6.1	0	31.8
Ice/Water Interface (km)	.8	0	.8	0	4.7	0	9.9	0	5.9	0	9.1	0	9.1	4.8	40.3	4.8

	ZONE															
	1		2		3		4		5		6		7		Total	
DATE OF SURVEY 1983	26-4	11-5	26-4	11-5	26-4	11-5	26-4	11-5	26-4	11-5	26-4	11-5	26-4	11-5	26-4	11-5
HABITAT																
Total Open Water (ha)	4	4	4	4	32	41	48	56	66	73	28	34	347	557	529	769
Shallow Water (ha)*	1	1	1	1	14	14	9	9	12	12	9	10	243	314	287	360
Exposed Mudflat (ha)	1	1	1	1	<1	14	3	7	<1	3	1	3	4	44	10	73
Shore/Water Interface (km)	.8	.8	.8	.8	4.1	6.9	5.3	5.7	9.7	9.4	4.5	5.0	4.9	13.7	30.1	42.3
Ice/Water Interface (km)	0	0	0	0	0	0	0	0	0	0	0	0	5.7	1.1	5.7	1.1

* shallow water <1 m deep

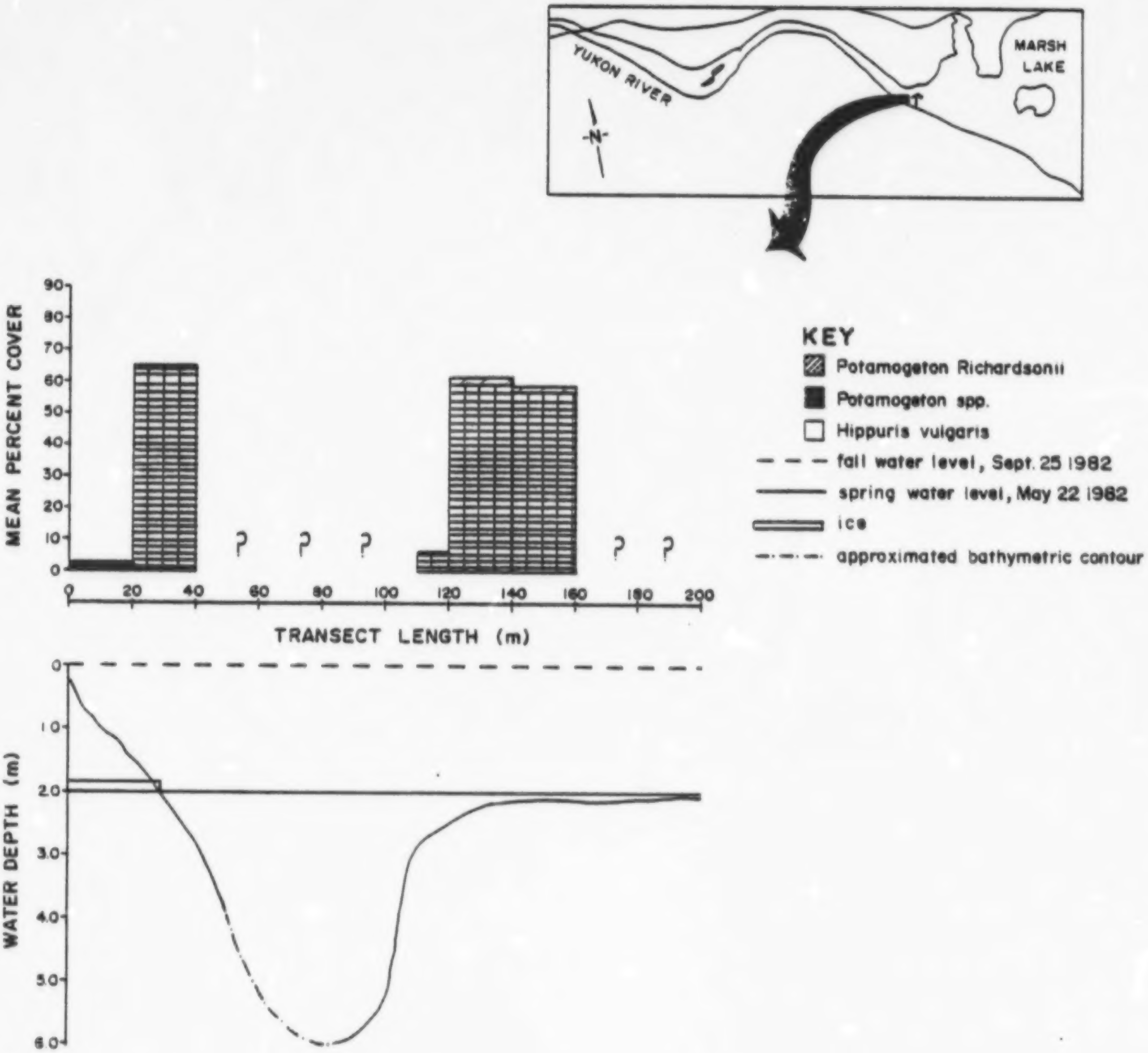


Figure 13 Waterdepth Profiles and Aquatic Vegetation at Zone 7. Marsh Lake Outlet.

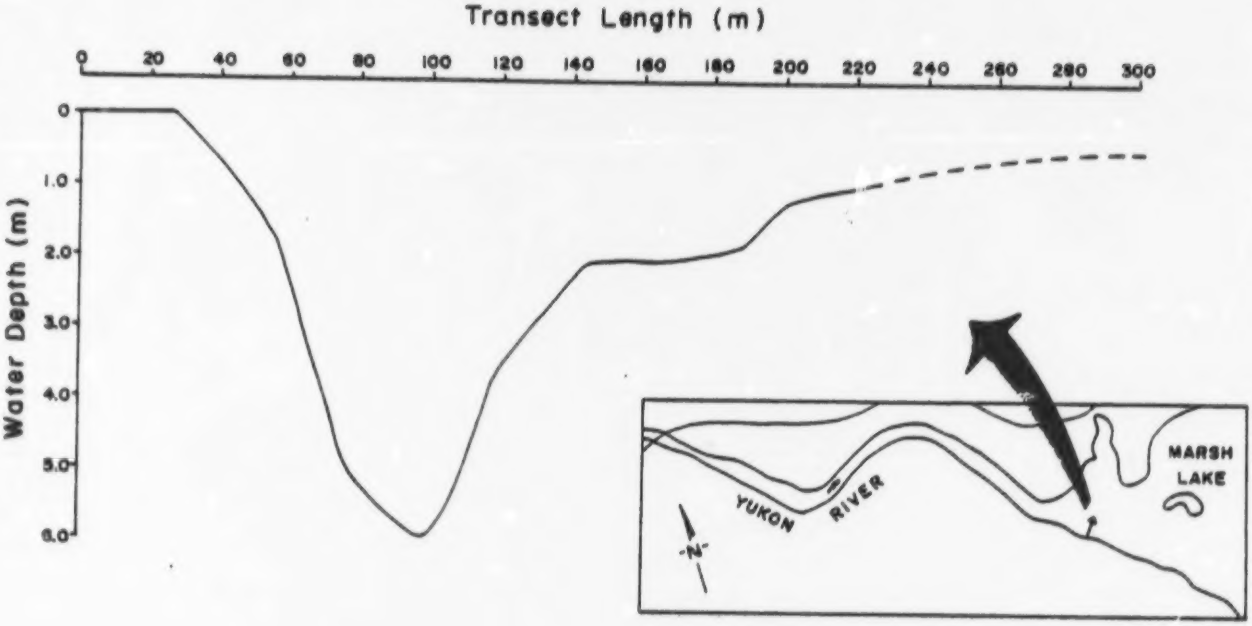


Figure 14 Waterdepth Profile at Zone 7. Marsh Lake Outlet

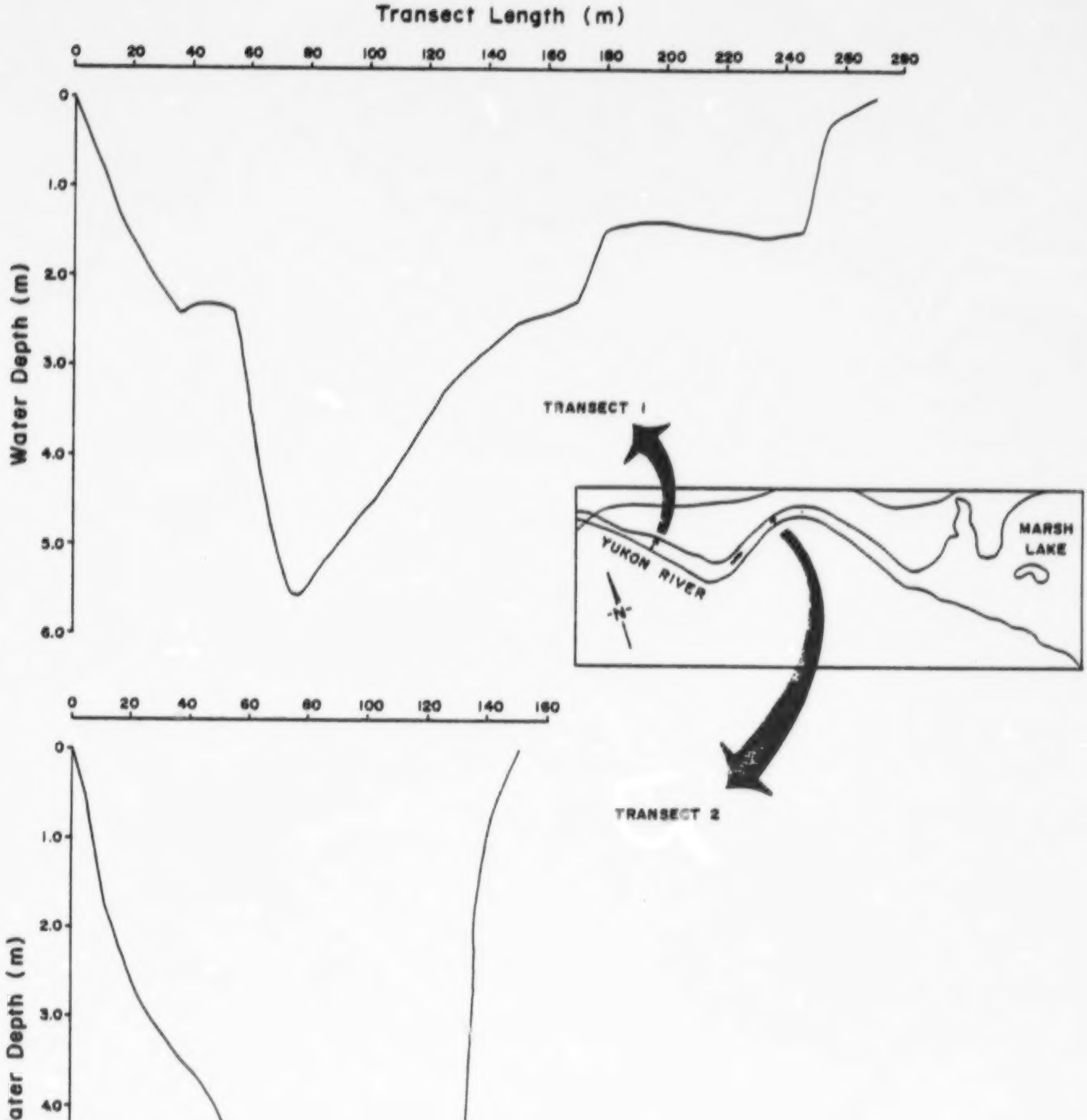


Figure 15 Waterdepth Profiles at Zones 5 and 3 of Yukon River, Marsh Site, 1983.

Differences in the amount of habitat types between the two years at the Marsh site follow the same pattern as discussed previously for all sites.

Tagish Site

The Tagish site has both a lake outlet (Zone 4) and a lake inlet (Zone 1). Both of these zones represented at least 30% of the total area of open water, and 30% of the area of mudflats for the site. Tagish Lake outlet had a larger area of open water (530 ha) than Marsh Lake inlet in late April (Table 15). The lake outlet had a 2 m deep channel where it entered the Tagish River (Figure 16). The west side of the lake bottom sloped more gradually than the east side, and offered a 55 m margin (from shore-edge out to channel) of shallow water. The channel at Marsh Lake inlet was 6 m deep in late May 1982 (Figure 17). The inlet (zone 1) had an area of shallow water comparable to the outlet in 1982 and greater than the outlet in 1983.

Shallow water was available during May of both years (Table 15). Exposed mudflats were largely present at zones 1, 2 and 4, yet they were not available until the May survey in 1983 and in 1982 were never well represented. By 11 May 1983 the ice/water interface was present only at zone 1 and in 1982 was greater than in the other three areas.

Teslin Site

The Teslin River had the deepest channel measurement among the staging sites. In 1982 the channel measured 6 m in zone 2 (Figure 18) and in 1983 measured 14 m in Zone 3 (Figure 19). Despite the deep channel, the Teslin River had an extensive shelf of shallow water throughout zones 1, 2 and 3. Although the river's area of shallow water was less than the shallow water available at the lake outlet, zone 4, the shallow areas were available both in late April and May (Table 16). Exposed mudflats were available at all zones. Comparable

TABLE 15 Tagish Lake Outlet - Distribution and Amount of Physical Habitat Types Among the Four Zones, Spring 1982 and 1983.

	ZONE									
	1		2		3		4		Total	
DATE OF SURVEY 1982	22-4	9-5	22-4	9-5	22-4	9-5	22-4	9-5	22-4	9-5
HABITAT										
Total Open Water (ha)	107	181	142	139	33	28	248	275	530	623
Shallow Water (ha)*	25	24	25	25	7	7	19	31	76	87
Exposed Mudflat (ha)	0	3	0	7	0	1	1	2	1	13
Shore/Water Interface (km)	0	3.1	0	10.7	0	2.8	1.1	2.2	1.1	18.8
Ice/Water Interface (km)	6.8	7.2	9.4	0	2.8	0	4.3	4.4	23.3	11.6

	ZONE									
	1		2		3		4		Total	
DATE OF SURVEY 1983	26-4	11-5	26-4	11-5	26-4	11-5	26-4	11-5	26-4	11-5
HABITAT										
Total Open Water (ha)	160	383	131	124	25	25	212	259	528	791
Shallow Water (ha)*	41	54	28	32	4	8	19	30	92	124
Exposed Mudflat (ha)	2	23	0	41	1	9	2	37	5	110
Shore/Water Interface (km)	1.5	5.2	9.5	10.7	2.2	2.5	1.8	4.2	15.0	22.6
Ice/Water Interface (km)	8.4	10.0	0	0	.2	0	2.0	0	10.6	10.0

* shallow water <1 m

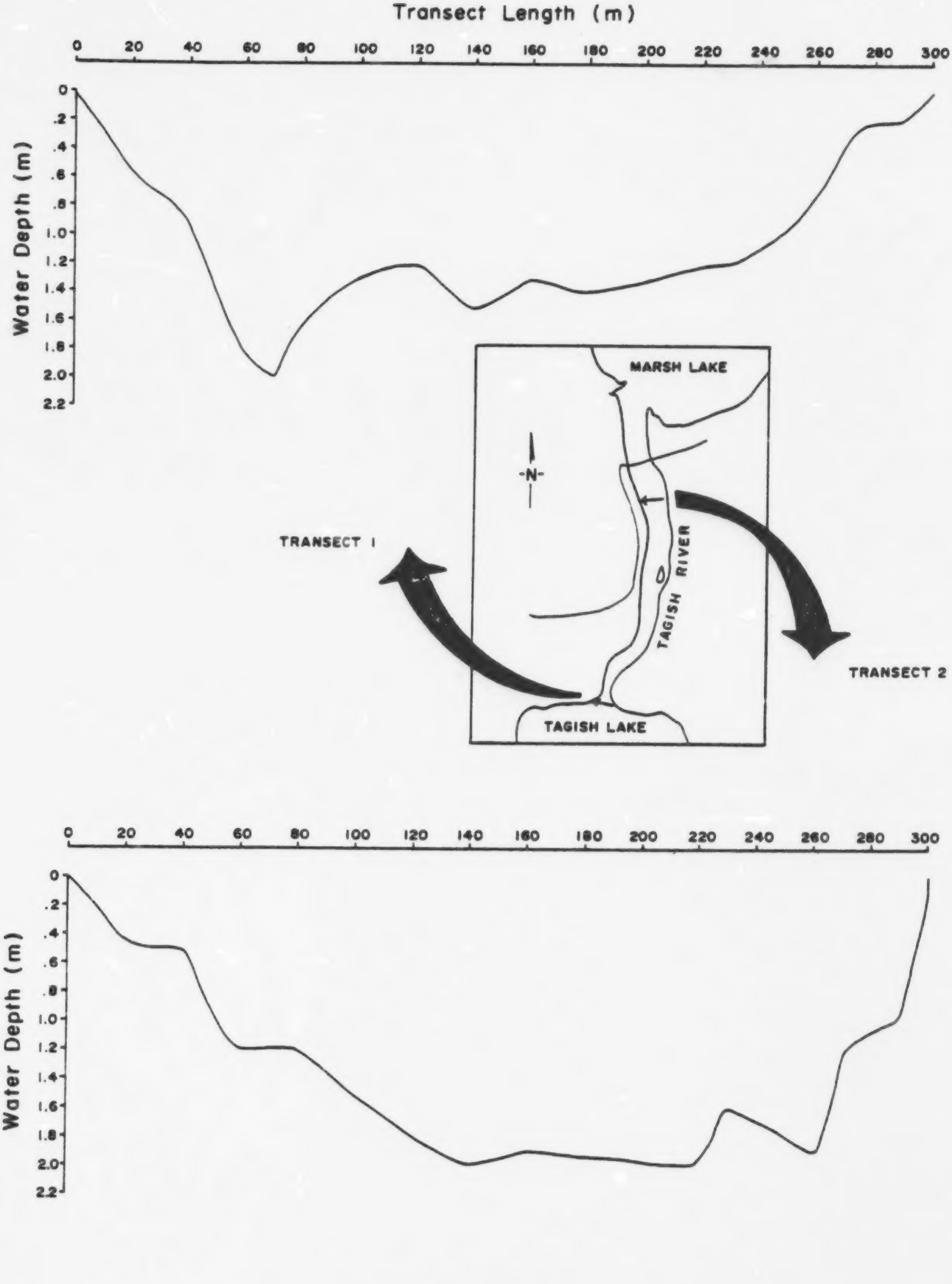


Figure 16 Waterdepth Profiles at Zones 2 (transect 1) and 4 (transect 2). Tagish Site. 1983.

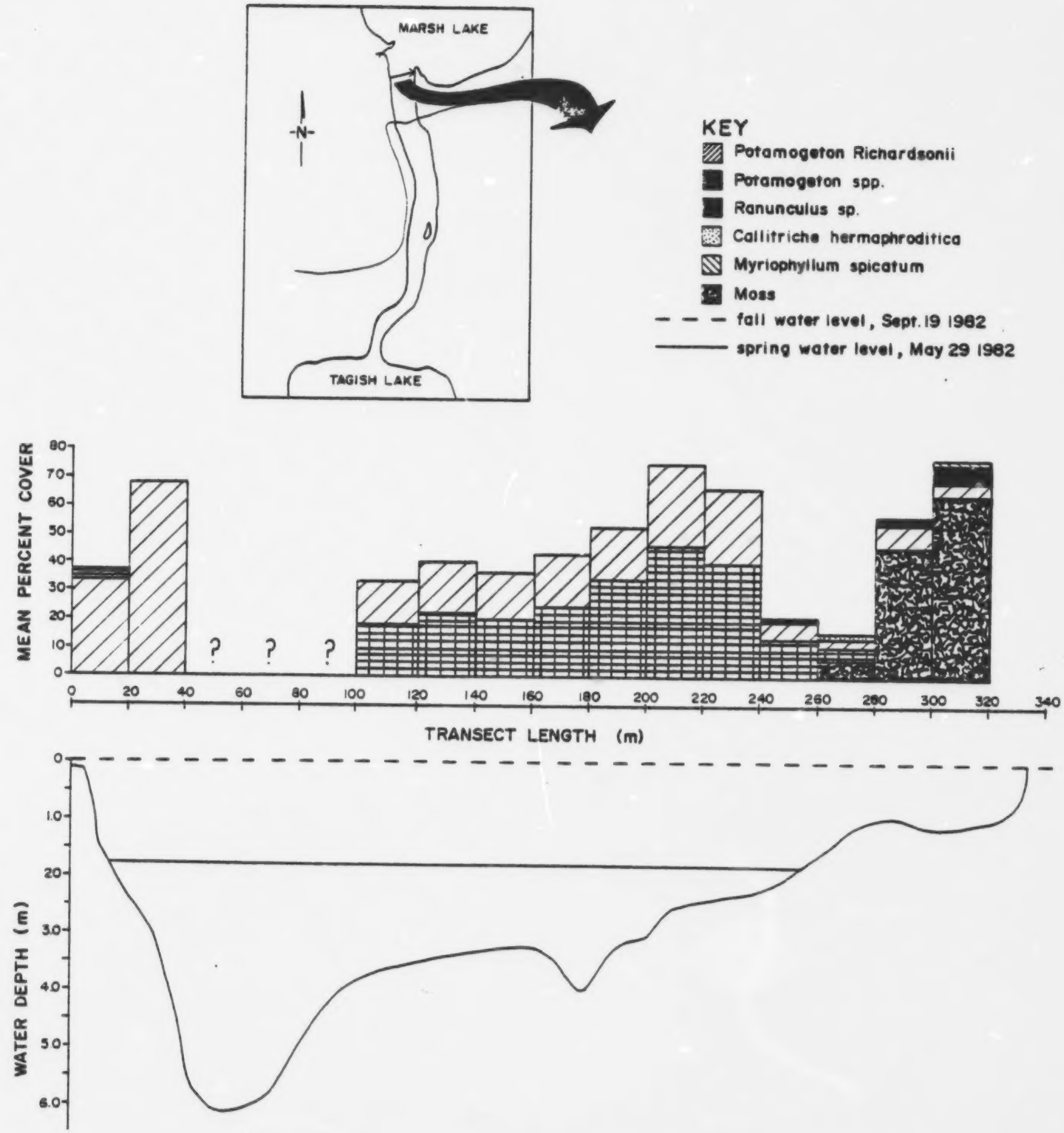


Figure 17 Waterdepth Profiles and Aquatic Vegetation at Zone 1, Marsh Lake Inlet, Tagish Site, 1982.

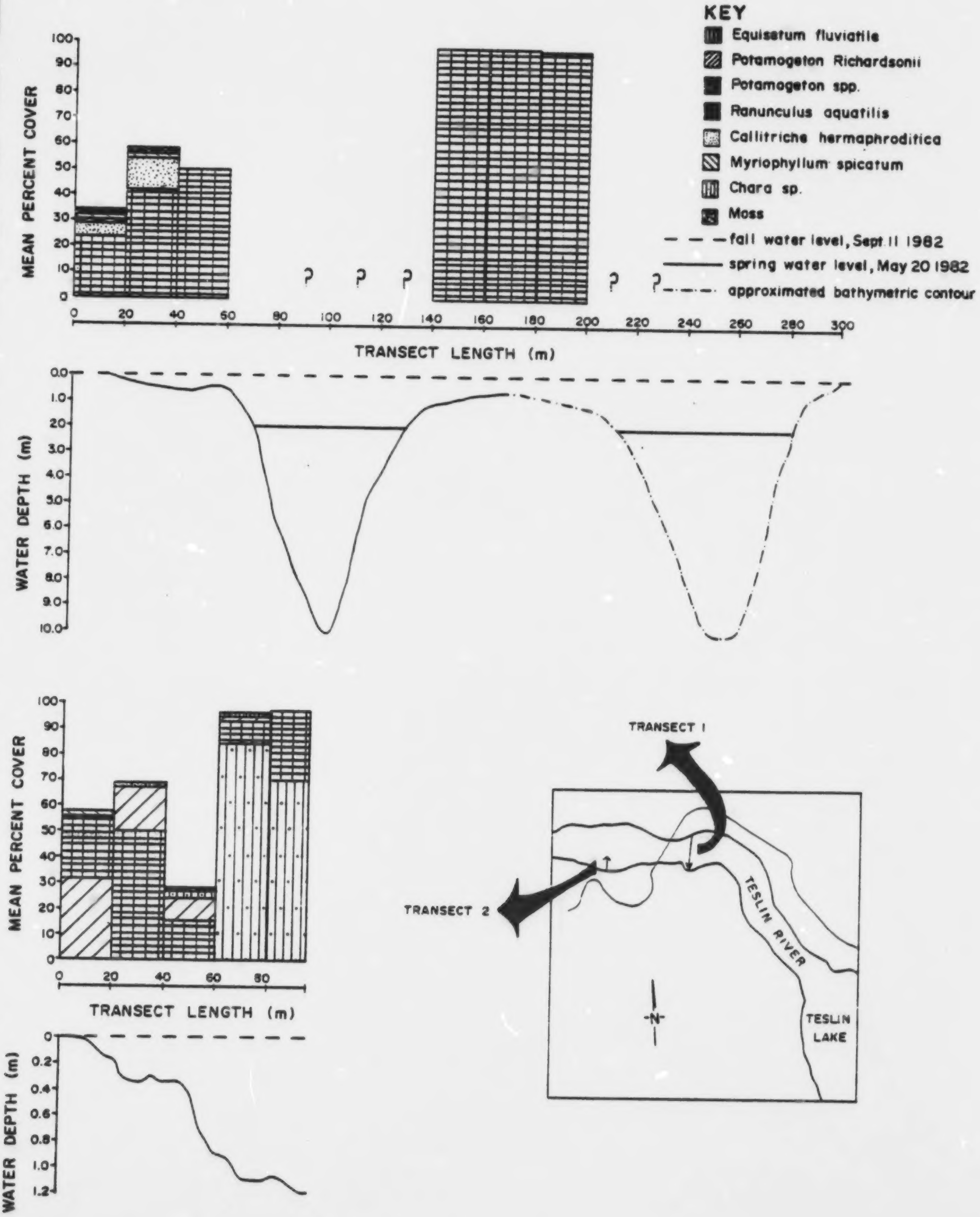


Figure 18 Waterdepth Profiles and Aquatic Vegetation at Zones 1 (transect 2) and 2 (transect 1) of Teslin River. Teslin Site. 1982.

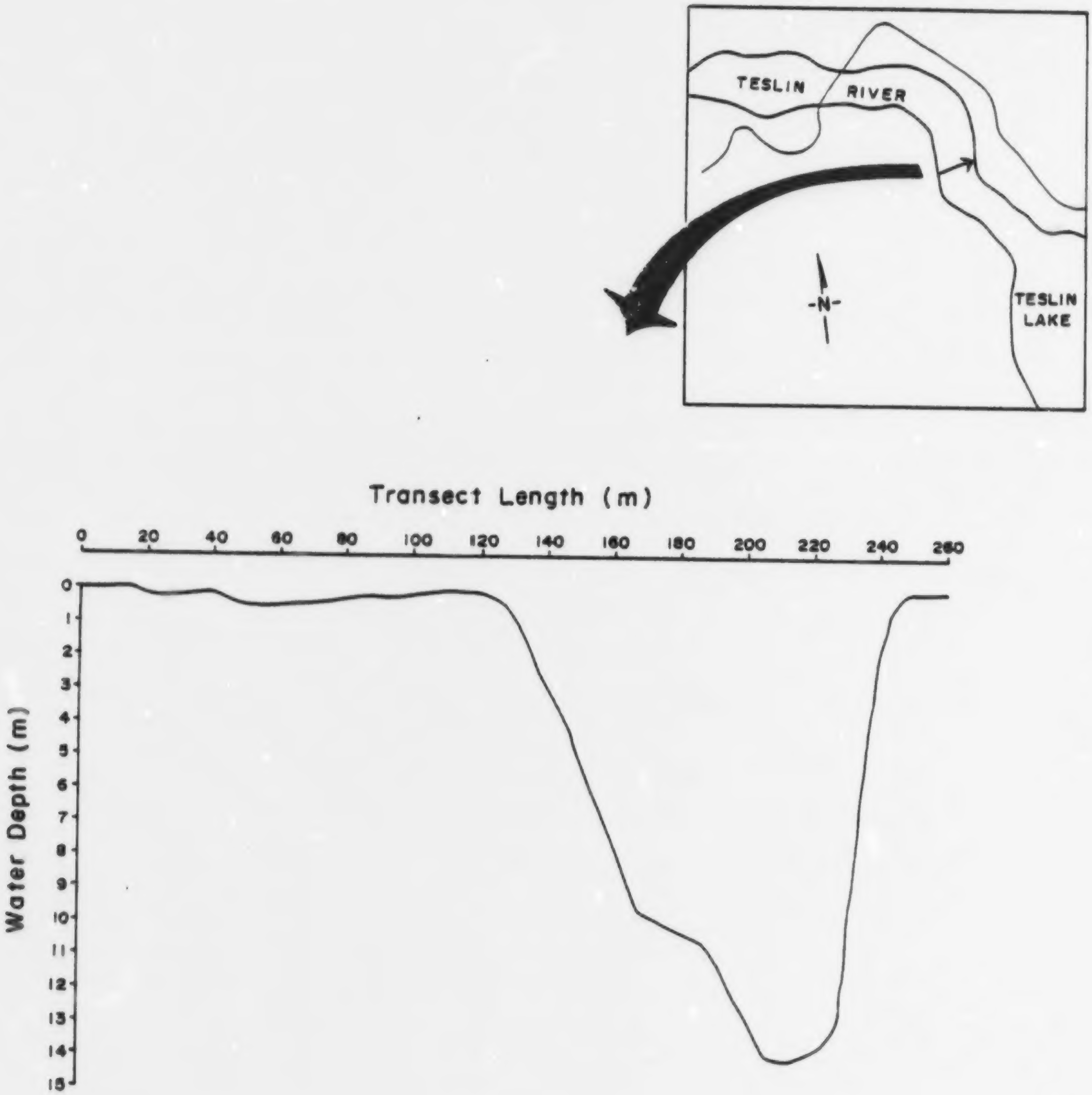


Figure 19 Waterdepth Profiles at Zone 3 of Teslin River, Teslin Site, 1983.

TABLE 16 Teslin Lake Outlet - Distribution and Amount of Physical Habitat Types Among the Four Zones, Spring 1982 and 1983.

	ZONE									
	1		2		3		4		Total	
DATE OF SURVEY 1982	22-4	9-5	22-4	9-5	22-4	9-5	22-4	9-5	22-4	9-5
HABITAT										
Total Open Water (ha)	17	26	25	42	25	4	40	106	107	178
Shallow Water (ha)*	0	10	4	10	8	12	17	31	29	63
Exposed Mudflat (ha)	0	16	0	14	0	13	0	60	0	103
Shore/Water Interface (km)	0	2.3	0	4.5	0	2.5	0	3.5	0	12.8
Ice/Water Interface (km)	3.1	0.8	4.0	0	4.5	2.5	3.8	2.3	15.4	5.6

	ZONE									
	1		2		3		4		Total	
DATE OF SURVEY 1983	26-4	11-5	26-4	11-5	26-4	11-5	26-4	11-5	26-4	11-5
HABITAT										
Total Open Water (ha)	26	37	42	45	35	52	83	401	186	535
Shallow Water (ha)*	7	19	12	20	14	28	68	257	101	324
Exposed Mudflat (ha)	8	27	5	16	2	49	0	241	15	333
Shore/Water Interface (km)	2.1	4.0	4.2	4.2	2.2	4.8	0	6.7	8.5	19.7
Ice/Water Interface (km)	1.4	0	0.6	0	2.3	0	5.1	0	9.4	0

* shallow water <1 m

with lake outlets at the Tagish and Marsh site, Teslin Lake outlet (zone 4) offered the most variety of habitat types. Major differences between years were the absence of mudflats and shore/water interface on 11 May 1983 unlike measurements of May 1982 (Table 16).

Little Atlin Site

Although shallow water was available at the Little Atlin site during the spring of 1982, it could not be defined on the aerial photos. Most of the lake within the study site is 5-10 m deep (Horler pers. comm.). Our measurements in 1982 showed the lake outlet to be at least 6 m deep. Shallow water areas along the lake edge coincided with emergent stands of the previous year's growth of vegetation (Figure 20). No mudflats ever occurred at Little Atlin Lake (Table 17). In late April all study zones had approximately 1 ha of open water yet by 9 May, 43 and 36% of the total area of open water was at zones 3 and 4, respectively.

Spring Water Levels

At the four study sites, water depths were lower in the spring than at any other time of year. Northern lakes characteristically receive no surface water inflow for five to seven months of the year during the winter, consequently water levels decrease during the course of winter and do not begin to increase until late April or early May during spring thaw (Alford pers. comm.). The low spring water levels at the staging sites were significant to waterfowl because feeding and loafing areas were made available. The low water levels allowed the exposure of the lake and river bottoms as mudflats along shore areas and as islands, and also allowed shallow areas for feeding.

Aquatic Vegetation

During 1982 aquatic vegetation sampling was conducted in May at the four staging sites to ascertain if any green (new growth) submergent plants were available to waterfowl during April and May.

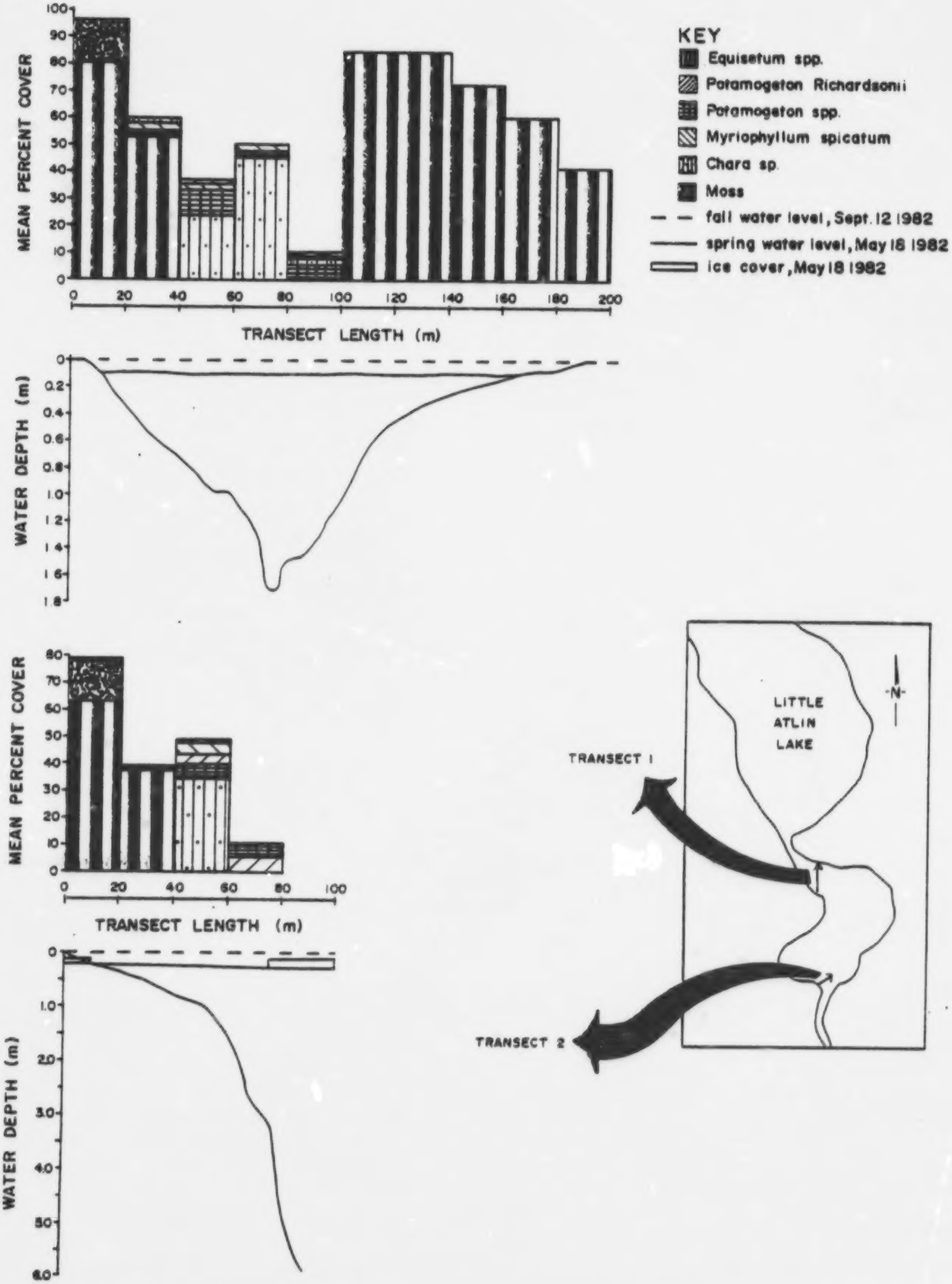


Figure 20 Waterdepth Profiles and Aquatic Vegetation at Zones 1 and 3. Little Atlin Site, 1982

TABLE 17 Little Atlin Lake Outlet - Distribution and Amount of Physical Habitat Types Among the Four Zones, Spring 1982.

	ZONE									
	1		2		3		4		Total	
DATE OF SURVEY 1982	22-4	9-5	22-4	9-5	22-4	9-5	22-4	9-5	22-4	9-5
HABITAT										
Total Open Water (ha)	1	1	1	2	1	6	1	5	3	14
Shallow Water (ha)*	-	-	-	-	-	-	-	-	-	-
Emergent Vegetation (ha)+	0	0	0	<1	0	6	0	<1	0	6
Shore/Water Interface (km)	0	0.2	0	0.1	0	0.8	0	0.1	0	1.2
Ice/Water Interface (km)	0.8	0	0.2	0.2	0.8	0.8	0.5	0.8	2.3	1.8

* shallow water <1 m deep

+ last year's growth

The extent of sampling was limited but revealed that apart from muskgrass (*Chara* spp.), a green algae, no "green" submergent macrophytes were available.

Preliminary summer sampling in 1982 suggested prolific growth of aquatic macrophytes at the staging sites. Pondweed, *Potamogeton* spp. was common to all sites and grew in abundance. Water milfoil, *Myriophyllum* spp. was common to all sites except Marsh, but occurred in low abundance (Figures 17, 18 and 20). Marsh was the only site where mare's tail, *Hippuris vulgaris* was noted (Figure 13). Horsetails, *Equisetum* spp. characterized the Little Atlin site. A list of all plants noted at the staging sites is appended (Appendix 8).

Strongly suspecting that the waterfowl (swans, geese and dabbling ducks) were eating rhizomes and roots, benthic sampling was conducted during May 1983 to determine the abundance of roots, rhizomes and tubers at the three major staging sites: Marsh, Tagish and Teslin. Unfortunately, sampling could not be initiated until mid-May, after the birds had concentrated and fed in the areas. Plant parts could not always be identified to species or genus and had to be grouped according to morphology and colour.

Marsh Site

The Marsh site was the only site where mare's tail (*Hippuris vulgaris*) was noted. Mare's tail was abundant (relative to other plants) in Marsh Lake outlet, zone 7 (Table 18). The Marsh site, including both the lake outlet and the Yukon River (zones 5 and 3) had the greatest variety of plants, among the three staging sites. Shoots, both red and green, which likely represented pondweed (*Potamogeton* spp.), were found in all of the Marsh sample areas, where they occurred more abundantly and extensively than at the Teslin or Tagish sites. The summer sampling at the lake outlet in 1982 revealed an abundance of pondweed (Figure 13). Muskgrass was noted at the lake outlet and was

TABLE 18 Biomass of Aquatic Vegetation at the Marsh Site. May 1983. Dry weight in grams/m^2, mean values from (n) replicates.

	ZONE 7					ZONE 3	
	loc 1		loc 2	loc 3		loc 4	
PLANT GROUP	mudflat n=10	<10m+ n=10	>10m+ n=10	<10m+ n=10	>10m+ n=10	<10m+ n=10	>10m+ n=10
Detritus	685.95	505.52	53.39	658.82	599.40	252.33	169.66
Muskgrass			.43	.86	.43	10.33	
Monocot	.86			T			
Nodes	.43	.43	T	T			
Shoots - green	.43	.43		.43	.86	.43	T
Shoots - red	.86	T	.43	.43	.43	3.01	.43
Rhizomes				.43		1.29	1.72
Mare's tail	T			5.60	T		
Water Milfoil					.43		
Horsetail	T						
Pondweed		T		T			
Buttercup			T		T		T
TOTAL*	2.58	.86	.43	6.89	1.72	4.73	2.15

+ from shore
T trace
* excludes detritus and muskgrass

especially abundant in the Yukon River, zone 3, <10 m from shore (Table 18). The highest abundance of measurable vascular aquatic plants was in zone 7 at the M'Clintock River delta, where mare's tail comprised >50% of the biomass (Table 18). Detritus was most abundant at the Marsh site, among the three study sites, and was more abundant at the lake outlet (686 gm^{-2}) than in the Yukon River (252 gm^{-2}). The amount of detritus was included in the results as it may indicate productivity; if this is true, Marsh Lake outlet and particularly the M'Clintock River delta were the more productive areas.

Teslin Site

Total biomass of live, vascular plants at the Teslin site was lower than at the Marsh or Tagish sites. Although many plant groups were noted at the Teslin site, most occurred in trace (<.01 g) amounts (Table 19). The plant group monocot, which was presumably a growth form of pondweed (Potamogeton spp.), was the most abundant plant group. This plant occurred primarily in zone 4 and in trace amounts in the river zones 2 and 3 (Table 19). During the summer sampling of 1982 pondweed was the principal submergent plant in the river at zone 2 (Figure 18). Nodes, which represent that stage of plant growth between seed and shoot in which the radical (embryonic root) had emerged, were most abundant (0.43 gm^{-2}) on the mudflats and in trace amounts elsewhere (Table 19). Nodes may offer high energy value, similar to seeds, to waterfowl.

Tagish Site

The Tagish site was sampled at Marsh Lake inlet, zone 1, the Tagish River, zone 2 and Tagish Lake outlet, zone 4. Essentially no vegetation was found at zone 4 (Table 20). The greatest plant biomass was at zone 1, where the plant group monocot comprised most of the total biomass. The mudflat in zone 2 had the greatest variety of plant groups, in appreciable amounts. Plant groups noted at the mudflats were shoots (green and red), nodes and monocot. The representation of these groups at the mudflat was also noted at the Marsh site yet not at the Teslin site. The summer sampling in 1982 revealed an abundance of pondweed in the Tagish River at zone 1 (Figure 17).

TABLE 19 Biomass of Aquatic Vegetation at the Teslin Site, May 1983. Dry weight in grams/m2, mean values from (n) replicates.

	ZONE 4				ZONE 2		ZONE 3	
	loc 1	loc 3			loc 4		loc 5	
PLANT GROUP	>10m+ n=3	mudflat n=5	<10m+ n=9	>10m+ n=10	mudflat n=4	<10m+ n=10	<10m+ n=7	>10m+ n=9
Detritus	13.78	67.70	166.64	6.46	120.57	183.44	265.25	43.49
Muskgrass	15.07	T		.86	T	14.64		
Monocot		.86	1.29	.43		T	T	
Nodes		.43	T	T		T	T	T
Shoots - green								T
Shoots - red			.43	T			T	T
Water Milfoil		T	.43	T	T	T	T	.43
Pondweed						T		T
Buttercup					T	T		
TOTAL*	0	1.29	2.15	.43	T	T	T	.43

+ from shore
T trace
* excludes detritus and muskgrass

TABLE 20 Biomass of Aquatic Vegetation at the Tagish Site. May 1983. Dry weight in grams/m^2, mean values from (n) replicates.

	ZONE 1			ZONE 2	ZONE 4		
	loc 1		loc 2	loc 3	loc 4		
PLANT GROUP	<10m+ n=5	>10m+ n=5	>10m+ n=5	mudflat n=10	mudflat n=5	<10m+ n=5	>10m+ n=5
Detritus	100.76	94.30	97.75	177.41	4.74		
Muskgrass	1.72	3.44	5.60	2.15	.43		
Monocot	7.75	T		.86			
Nodes	T	T	T	.43			
Shoots - green		T		.86			
Shoots - red			.43	1.29			
Water Milfoil		T	T				
Pondweed			T				
Buttercup		T					
TOTAL*	7.75	T	.43	3.44	0	0	0

+ from shore
T trace
* excludes detritus and muskgrass

Little Atlin Site

The Little Atlin site was not sampled for aquatic plant growth in 1983. Sampling in 1982 revealed a preponderance of horsetails (Equisetum spp.), (Figure 20). Muskgrass was noted at the deeper water depths and pondweed was recorded in limited abundance. None of the three other staging sites supported the prolific growth of horsetails as noted at Little Atlin Lake outlet.

The low values of plant biomass values recorded at the three staging sites may have been a consequential effect of extensive feeding by concentrations of waterfowl at these sites prior to sampling, and may also be a reflection of the small area sampled relative to plant distribution. In coastal salt marshes where snow geese had staged during spring migration, 58% of the plant biomass had been removed by the geese (Smith and Odum 1981). The cumulative total area sampled with the Eckman grab in this study, represented a small area relative to the total area available, thus limiting the interpretation of the results.

Behaviour and Habitat Use Patterns

Waterfowl behaviour, activity budgets and habitat use within the four staging sites under intensive study is presented for the more abundant species groups below and for specific abundant species under Species Accounts. The behaviour and habitat use of species groups within the available habitats was calculated using the census data from 1982 and 1983. Thus waterfowl activity and use of these habitats is applicable only to daylight hours (0600-1600), the time when most counts were conducted.

All Waterfowl

As presented earlier, the area of open water, area of exposed mudflat and area of shallow water was calculated on two dates during each spring for each zone/site combination. The relationship of these habitat parameters with waterfowl numbers was investigated by multiple regression (forward step-wise) of waterfowl numbers on the habitat parameters. Although other habitat parameters were estimated, only these 3 were tested as we intuitively felt they were potentially the most important in influencing the distribution of waterfowl. A summary of the multiple regression of waterfowl on habitat is presented in Appendix 9 for 1982 and 1983.

In 1982, at Marsh, the area of mud accounted for most of the variation in waterfowl numbers between zones. Little correlation between the habitat variables measured and waterfowl numbers was noted at Teslin or Tagish.

During spring 1983 the area of shallow water and area of mud at Marsh and Tagish were the two most important variables. In all three major sites the amount of open water was not important in predicting the number of waterfowl using each zone within a site. In general, the areas of mud and shallow water appear to be the two most important habitat variables tested in predicting the number of waterfowl. However, the generally low R^2 values (except Marsh 1982) suggest waterfowl distribution is also attributable to other untested variables.

Dabbling Ducks

Dabbling ducks, at all sites except Little Atlin, spent more time feeding than loafing, in both years. Other than these two behaviour activities, little time was spent flying or courting by dabbling ducks (Table 21). At Little Atlin Lake, dabbling ducks spent more time loafing than feeding.

In both years, ducks loafed in all habitat types available (Figure 21) except in emergent vegetation, which occurred only at the Little Atlin site. During spring 1982, most loafing occurred along ice-edges at the Marsh and Tagish sites and particularly at the Little Atlin site. At the Teslin site, dabbling ducks loafed on ice-edges and also used the areas < 10 m from the shore and ice. Loafing activity in 1983 occurred on mudflats and < 10 m from shore-edge.

Feeding was done in areas < 10 m from shore and on mudflats, during both years, at the three major sites. At the Marsh site, > 40% of the dabbling ducks counted fed in the open water area. At the Little Atlin site, many of the dabbling ducks fed in the emergent vegetation, which consisted of stands of *Carex* spp. and *Equisetum* spp.,

TABLE 21 Activity of Dabbling Ducks at Staging Sites. Spring 1982 and 1983. Total dabbling ducks (n) recorded during all census periods.

		% ACTIVITY				
SITE	YEAR	LOAF	FEED	FLY	COURT	n
Marsh Lake Outlet	1982	42.1	57.6	0.3	<0.1	6251
	1983	22.1	74.1	1.8	2.0	5807
Tagish Lake Outlet	1982	40.0	56.7	3.1	0.2	8748
	1983	27.0	71.9	0.8	0.3	4700
Teslin Lake Outlet	1982	32.7	66.7	0.4	0.2	5245
	1983	34.2	56.3	9.4	0.1	3112
Little Atlin Lake Outlet	1982	64.3	31.3	4.2	0.2	816

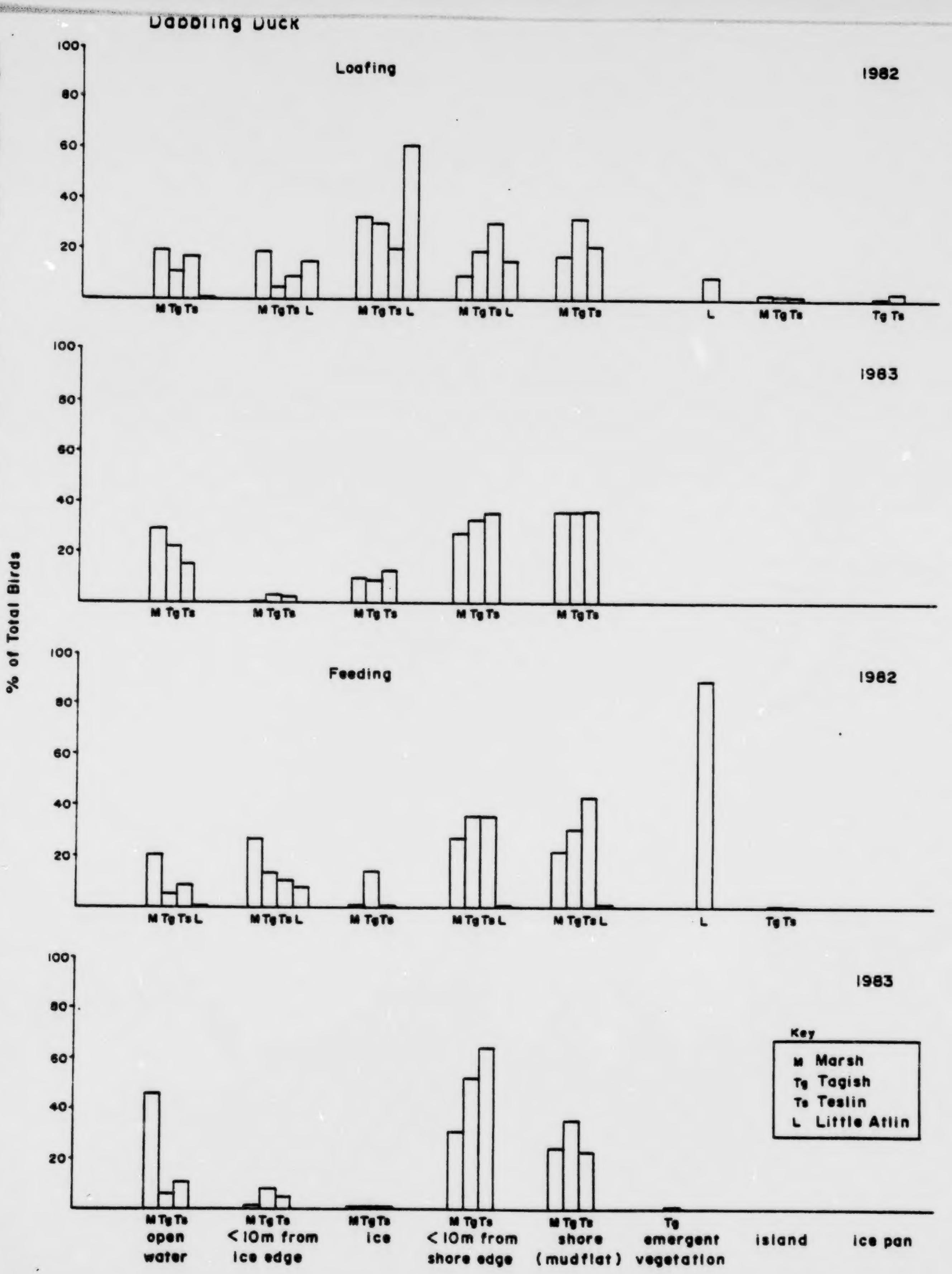


Figure 21 Percent of Total Dabbling Ducks Loafing and Feeding in Respective Habitats. 1982 and 1983.

of the previous year's growth. Although not quantified, most feeding on mudflats was restricted to the water portions along the shoreline, standing pools of water, and wet mudflats adjacent to melting ice pans on the mudflats.

Diving Ducks

At the Marsh, Teslin and Little Atlin sites, in both years, more diving ducks loafed than fed (Table 22). Only at the Tagish site was the proportion of diving ducks observed feeding similar to the proportion loafing. Since diving ducks feed below the surface there undoubtedly was observer bias in assigning some divers to loafing when in fact the ducks were resting between feeding dives. Nonetheless, divers did spend a much higher proportion of time loafing than did dabbling ducks and observers did try to account for the feeding behaviour of diving ducks in assigning them to behaviour activities.

Most of the diving ducks used open water areas for feeding and loafing, in both years (Figure 22). In 1982 substantial loafing also occurred in areas < 10 m from ice-edges and shore-edges however few diving ducks occurred in these habitats in 1983. The extremely high use of area < 10 m from ice-edge for both feeding and loafing at Little Atlin was a function of the small area of open water. Although proportionately of little significance, it was interesting to note that a few diving ducks fed on exposed shoreline at Marsh and in emergent vegetation at Little Atlin.

Swans

More swans fed than loafed, at the Marsh, Tagish and Teslin sites (Table 23), and considerably more swans fed than loafed in 1983 than in 1982. However, in 1983 at the Teslin site and in 1982 at the Little Atlin site, the majority of swans were recorded as flying, meaning the birds were leaving the area and their previous activity could not be determined. Although swans were likely flushed by the observers at

TABLE 22 Activity of Diving Ducks at Staging Sites, Spring 1982 and 1983. Total diving ducks (n) recorded during all census periods.

SITE	YEAR	% ACTIVITY				n
		LOAF	FEED	FLY	COURT	
Marsh Lake Outlet	1982	66.2	31.5	0.6	1.7	2844
	1983	57.0	37.1	3.3	2.6	2609
Tagish Lake Outlet	1982	46.3	47.7	2.0	4.0	4910
	1983	45.4	52.1	1.0	1.5	1465
Teslin Lake Outlet	1982	68.3	26.7	2.1	2.9	1399
	1983	59.4	33.1	6.1	1.4	1010
Little Atlin Lake Outlet	1982	78.9	15.9	1.4	3.8	1045

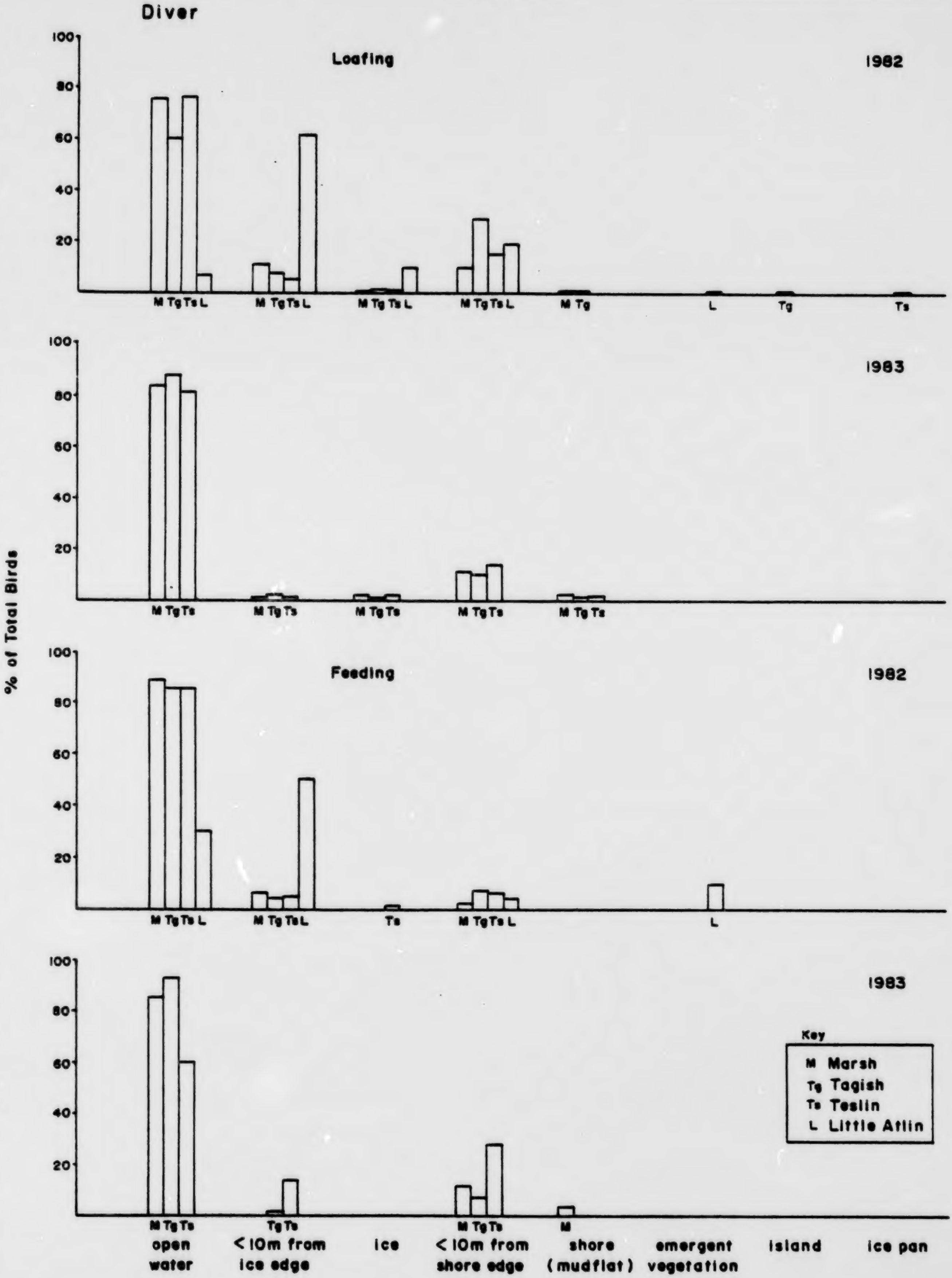


Figure 22 Percent of Total Diving Ducks Loafing and Feeding in Respective Habitats. 1982 and 1983.

TABLE 23 Activity of Swans at Staging Sites. Spring 1982 and 1983. Total swans (n) recorded during all census periods.

SITE	YEAR	% ACTIVITY				n
		LOAF	FEED	FLY	COURT	
Marsh Lake Outlet	1982	38.6	56.9	4.3	0.2	1703
	1983	11.9	68.1	20.0	0	3582
Tagish Lake Outlet	1982	42.4	53.0	4.6	0	526
	1983	31.6	56.2	11.7	0.5	1272
Teslin Lake Outlet	1982	21.5	73.1	4.5	0.9	873
	1983	23.8	22.7	53.5	0	1710
Little Atlin Lake Outlet	1982	29.0	8.1	62.9	0	62

Little Atlin Lake and possibly flushed by boat traffic at Teslin Lake, even at the Marsh and Tagish sites more swans took to the wing than any other species group. As noted previously, behaviour data from counts were only collected between 0600-1600 hours; when compared to intensive behaviour watches which were conducted over an extended time frame, swan behaviour was somewhat different (see Species Accounts).

In 1982 and 1983, most swans loafed on ice-edges or <10 m from ice-edges at all sites (Figure 23.). Additionally, at the Marsh site, swans also loafed in open water.

In both years, feeding occurred in areas <10 m from shore-edges and ice-edges and in open water. Although open water was used at Marsh Lake outlet (zone 7) more than anywhere else, this was due to zone 7 having over half of the open water area < 1 m deep; thus swans are not so restricted in where they fed in this zone compared to zones at other sites. A small proportion of swans were noted feeding on ice pans at the Marsh site and on mudflats at the Teslin and Marsh sites.

Waterbird Species Accounts

Arctic Loon

This species was rare in the study area. In 1982 it comprised <0.1% of the waterbirds, while in 1983 the species was never observed. This species was a late migrant to the study area. The first and only sightings were made 15 and 16 May when 10 were counted at the Teslin site and 8 were counted at the Marsh site (Appendix 10).

Milligan (1978) recorded this species as rare in 1978. He recorded one at Marsh Lake outlet on 3 May 1978.

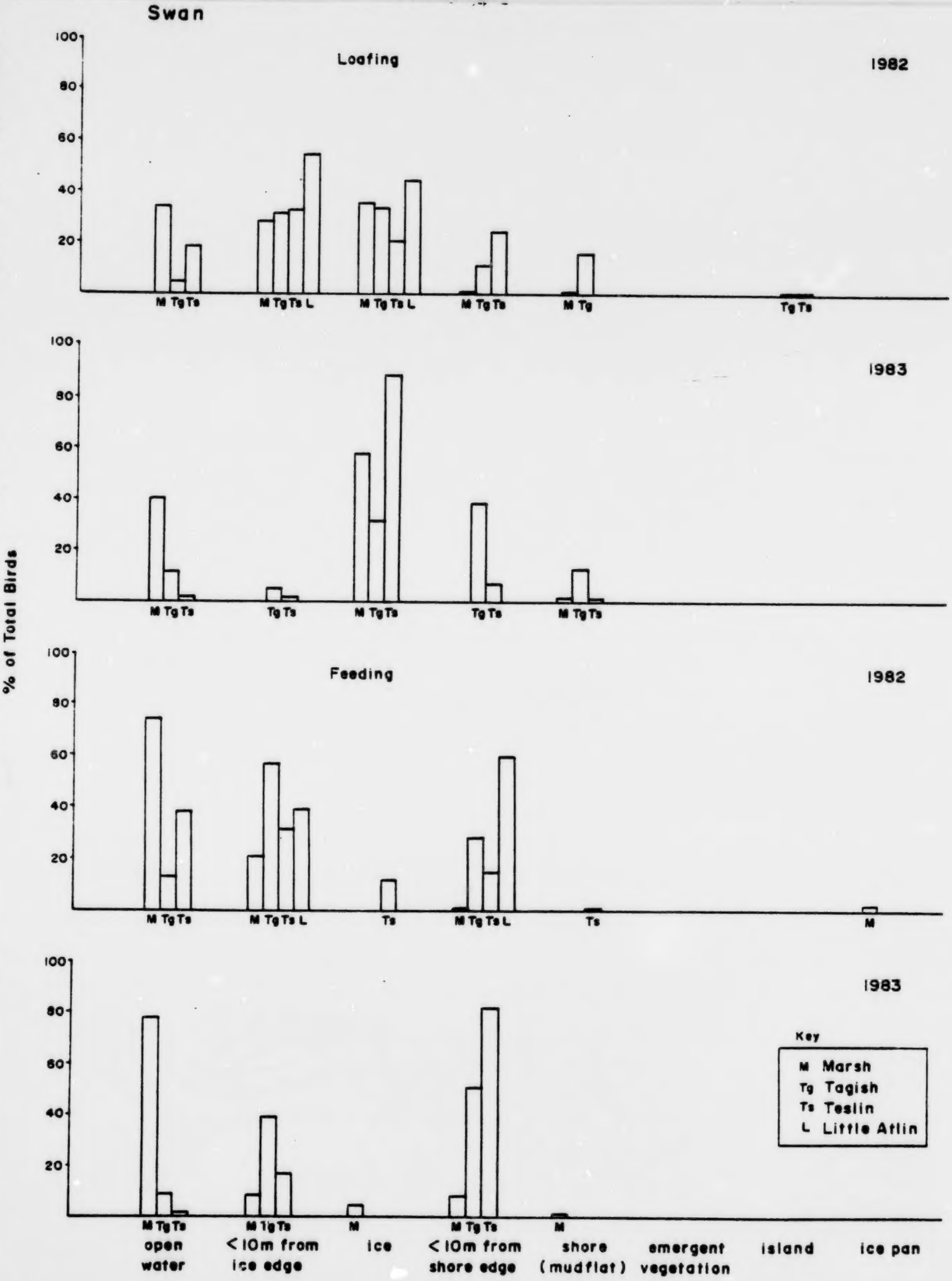


Figure 23 Percent of Total Swans Loafing and Feeding in Respective Habitats 1982 and 1983.

Common Loon

The Common Loon, although more abundant than the Arctic Loon, comprised only 0.3% of the waterbirds counted during both study years. The Common Loon was a relatively late migrant with the first noted arrivals on 11 May 1982 and 5 May 1983, which was during and after the peak migration of most waterbird species. This species was observed at all sites except Little Atlin during 1983 (Appendix 11). During 1982 and 1983, most of the Common Loons were counted at Tagish, where their cumulative total was 69 in 1982 and 47 in 1983. Tallies at the other sites numbered less than 25 birds. Common Loons remained in the study area up to the end of the surveys, in late May. Peak numbers occurred on 15 May 1982 (42 birds) and 13 May 1983 (28 birds), at Tagish.

In 1978, Common Loons were observed as early as 2 May at M'Clintock Bay (Milligan 1978).

Horned Grebe

Horned Grebes were observed at all four sites in 1982 and at all sites except Little Atlin Lake in 1983. Earliest arrival dates for the species were 4 May (4 birds) in 1982 and 27 April (2 birds) in 1983. Peak arrival dates averaged roughly 8 or 9 days earlier in 1983 than in 1982 (Figure 24). The highest numbers in 1982 were observed from 11 to 20 May, with a maximum of 116 birds on 16 May at Tagish Lake. In counts at Marsh Lake outlet, from 13 April to 5 May 1978, the highest numbers of Horned Grebes (9 birds) were observed in the period from 24 to 29 April (Milligan 1978). The greatest Horned Grebe abundance was observed at the Tagish site; counts in which Horned Grebes were observed averaged 35 and 15 Horned Grebes in 1982 and 1983 respectively.

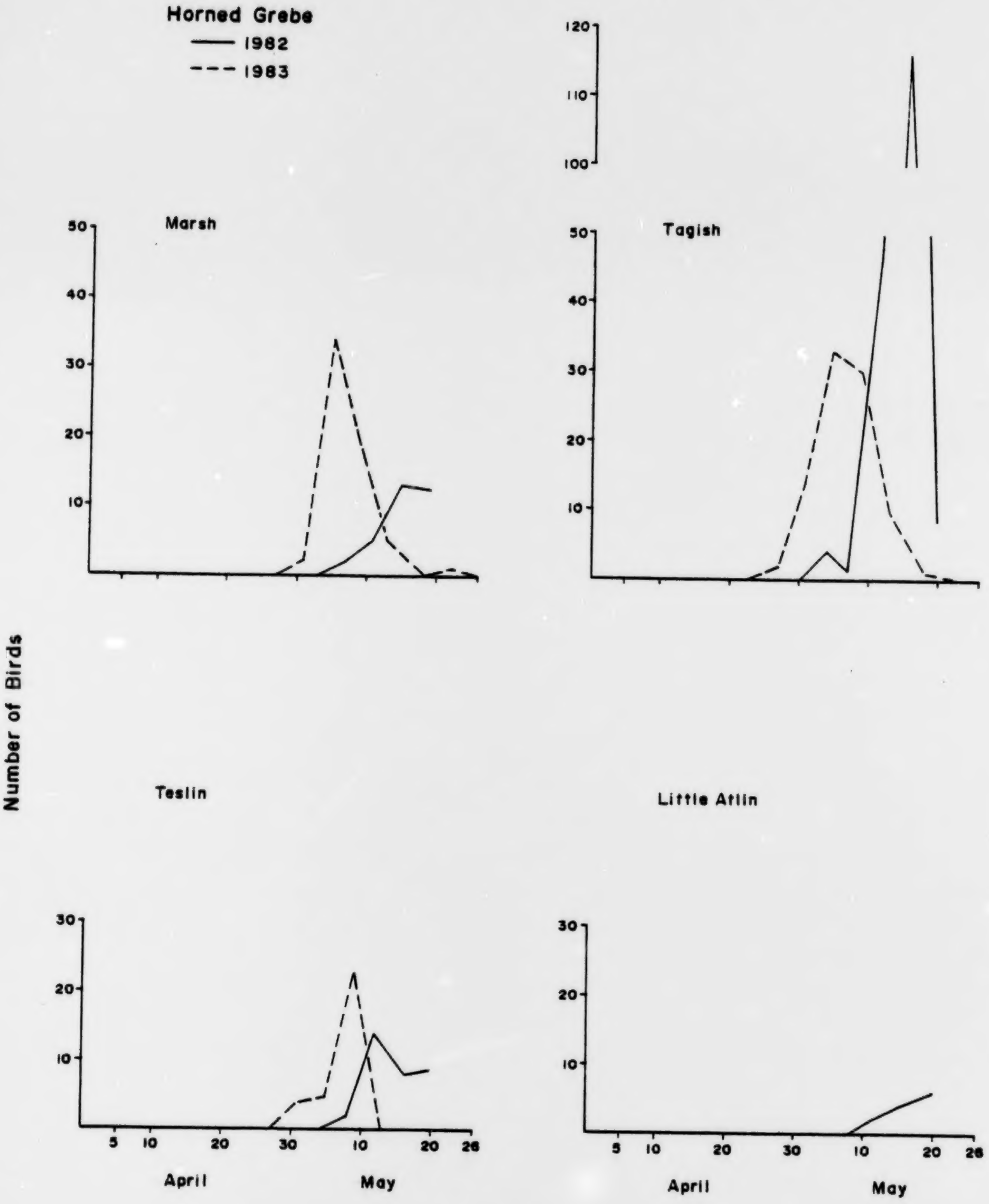


Figure 24 Number of Horned Grebes Counted During Census Periods in 1982 and 1983.

Red-necked Grebe

Red-necked Grebes were observed at all four sites in 1982, with maximum numbers observed at each site ranging from 22 to 101 birds. However in 1983, the species was observed only at the Teslin site and in small numbers (maximum of 2) at the Marsh site. The earliest dates on which Red-necked Grebes were observed were 11 May in 1982 and 5 May in 1983. Peak numbers in 1982 were noted between 15 to 20 May, with highs on 16 May of 60 birds at Teslin Lake and 101 birds at Tagish Lake (Figure 25). In 1983, a peak count of 30 birds was made at the Teslin site on 13 May.

Trumpeter Swan and Tundra Swan

By late April 1982 and mid-April 1983 all swans could not be differentiated to species. Thus much of the data on swan abundance and distribution (Figure 26) is discussed by species group and appears throughout the results. Some interesting observations follow, which are not presented elsewhere.

Six Trumpeter Swans observed at the Tagish site on 1 May wore coloured neck bands. Five of these birds were banded at Powell River, British Columbia, in February 1981 and the other was banded on its breeding grounds near Fairbanks, Alaska. The latter swan was apparently paired with one of the Powell River swans. Swans from Powell River are known to breed near Fairbanks (McKelvey, pers. comm.).

Trumpeter Swans arrived much earlier than Tundra Swans on the staging sites. Trumpeter swans were first noted on 12 April 1982 and 28 March 1983, 8 and 16 days earlier than Tundra Swans in 1982 and 1983 respectively.

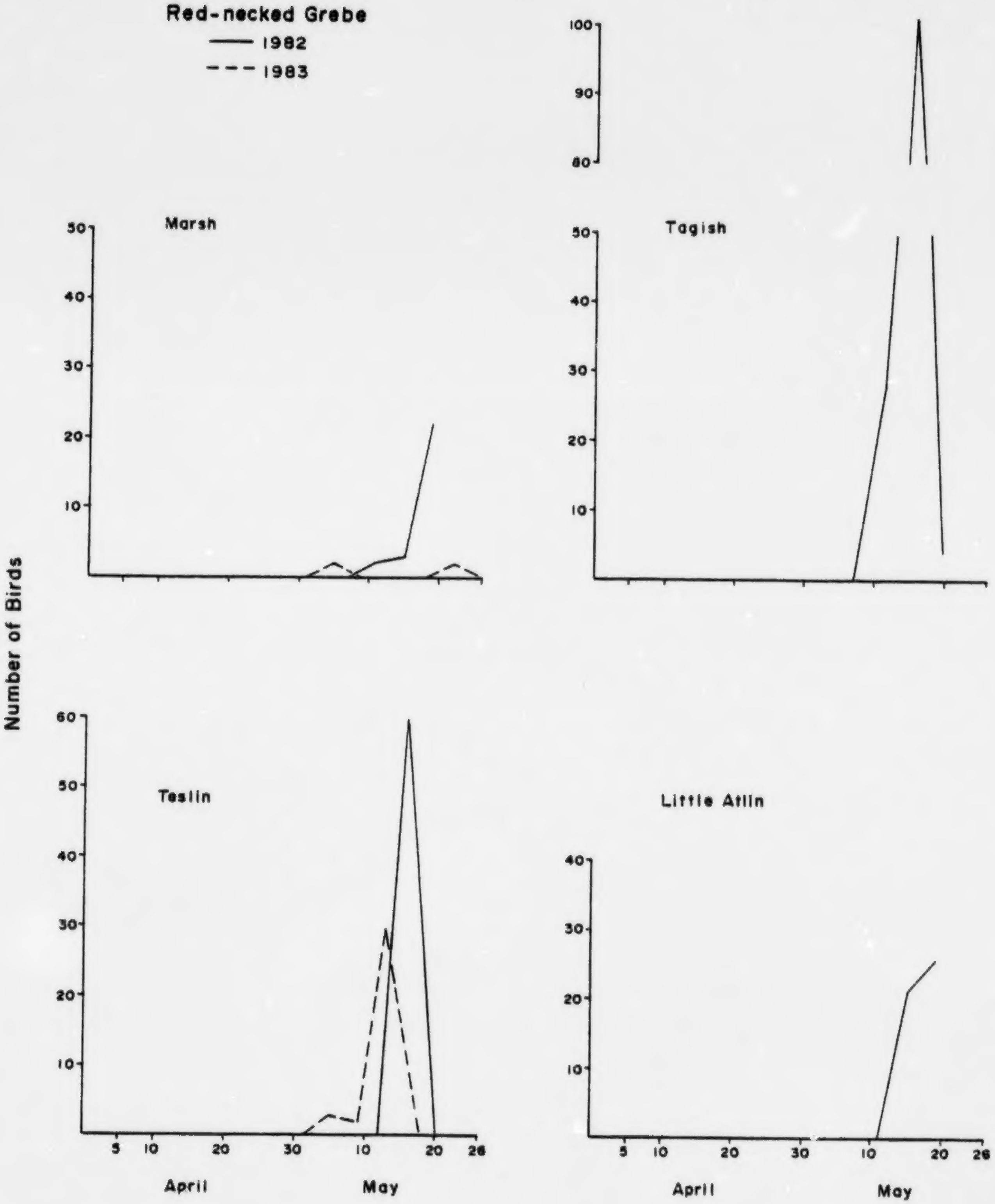


Figure 25 Number of Red-necked Grebes Counted During Census Periods in 1982 and 1983.

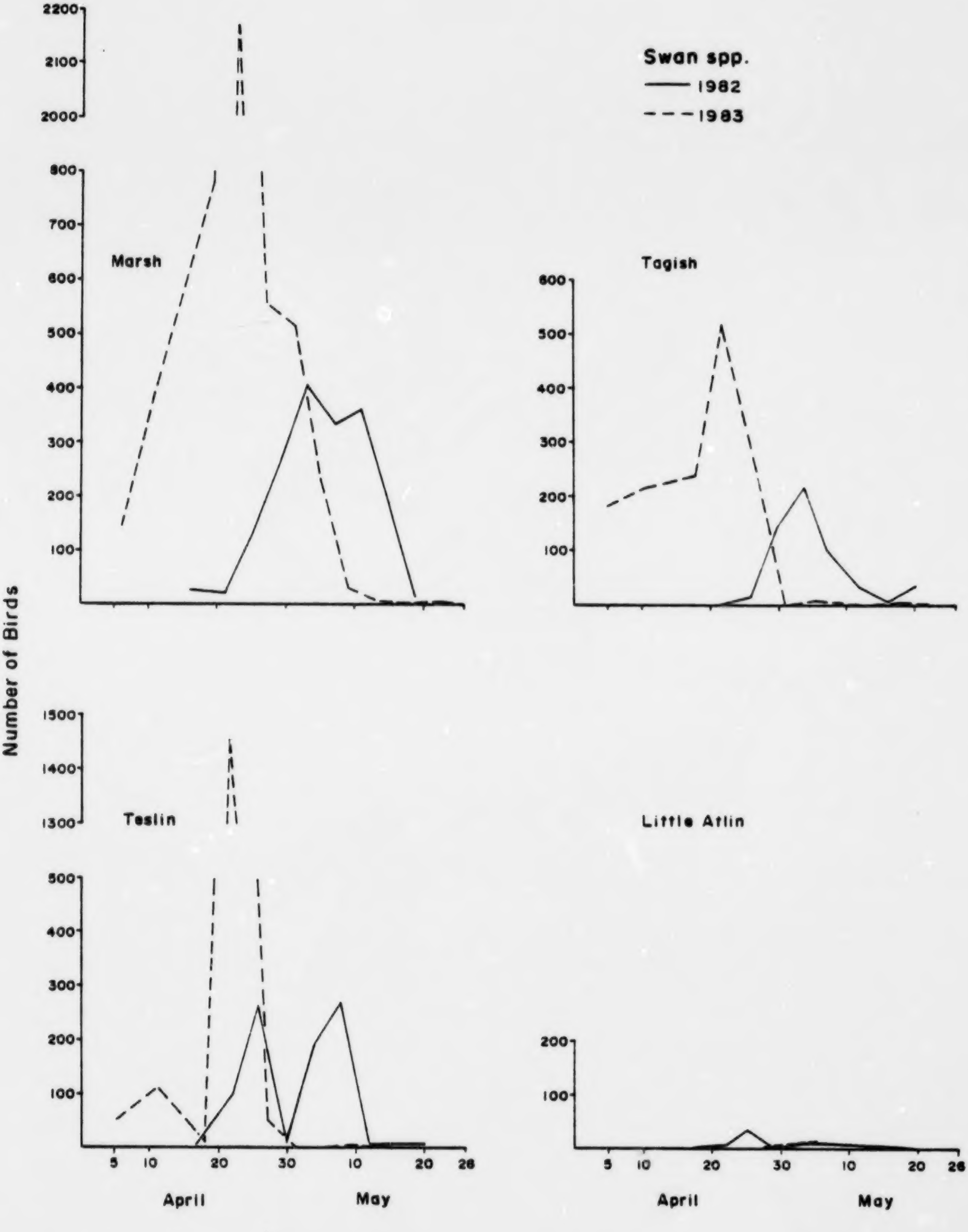


Figure 26 Number of Swans Counted During Census Periods in 1982 and 1983.

The maximum daily number of identified Trumpeter Swans was eight at Little Atlin on 25 April and 3 May, 308 at Marsh on 3 May, 67 at Teslin on 22 April, and 123 at Tagish on 30 April, in 1982. In 1983 a maximum of 808 or 10% of the Alaskan Trumpeter Swan population (King and Conant 1981) were present at Marsh, Tagish and Teslin on 16 April 1983. Approximately 90% were in zone 7, Marsh Lake.

Intensive behavioural observations (15 minute intervals) at Teslin, Marsh and Tagish sites in 1982 allowed determination of an activity budget for swans as a group (Table 24). At Teslin and Tagish, activity was more or less evenly divided between feeding and loafing (58% feeding and 42% loafing at Tagish, and 49% feeding and 50% loafing at Teslin). At Marsh Lake, feeding comprised 81% of the activity budget and loafing 17%. Although all feeding activity was subsurface, a small amount of surface feeding was observed at Teslin.

During censuses in 1982 and 1983, enough Trumpeter Swans were identified to enable us to say something about the activity and habitat useage of this species, as distinct from Tundra Swans. Over all lakes, the activity of individual Trumpeter Swans observed on censuses was composed as follows: in 1982, 51% feeding, 36% loafing, 13% flying, and less than 1% courting, and in 1983, 65% feeding, 22% loafing and 13% flying. At Marsh, Tagish and Teslin, repectively, the ratio of feeding birds to loafing birds was 1.4:1, 1.6:1 and 2.2:1 in 1982 and 33.6:1, 1.8:1 and 2.6:1 in 1983. Of the four sites, Marsh Lake appears to be the most important staging area, based on the two years' data. Not only were Trumpeter Swans much more numerous at the Marsh Lake site, but the degree of feeding activity was also high.

Table 25 shows the habitat useage of Trumpeter Swans observed at the four sites during censuses. For the most part, feeding Trumpeter Swans used shallow water areas, areas less than 10 m from ice or areas less than 10 m from shore. However, at Marsh Lake, where the largest numbers of Trumpeter Swans were recorded, most feeding birds were

TABLE 24 Activity Budget of Swans, Spring 1982. From intensive behaviour watches.

		ACTIVITIES, % TIME									
		LOAF				FEED@			OTHER		NO. 15 MINUTE SCAN SAMPLES*
LOCATION	DATE	AWAKE§	PREEN	SLEEP	TOTAL	SUB-SURFACE	SURFACE	TOTAL	AGONISTIC†	FLY	
Teslin	April 22	26.8	7.3	6.8	40.9	55.2		55.2	3.9		18
	April 26	15.9	1.6	36.7	54.2	44.5		44.5	1.4		9
	April 30	20.2	10.9	11.8	42.9	57.1		57.1			15
	May 16	11.1	31.1	20.0	62.2	31.1	6.7	37.8			12
	Mean				**50.0**			**48.6**			
Marsh	April 28	7.1	1.7	1.2	10.0	88.6		88.6	1.4		39
	May 6	15.8	10.3	9.9	36.0	62.7		62.7	1.1	0.2	26
	May 14	2.4	2.4		4.8	90.5		90.5	4.8		5
	Mean				**16.9**			**80.6**			
Tagish	May 1	23.3	8.7	9.6	41.6	57.8	0.1	57.9	0.4		32
All Locations	**Mean**	**15.3**	**9.3**	**12.0**	**36.6**	**60.9**	**0.8**	**61.8**	1.6	**>0.1**	**TOTAL**
	S.D.	8.2	9.6	11.8	19.9	20.2	2.4	18.9	1.8		156

@ Subsurface refers to feeding with head below water surface; surface feeding includes feeding on water surface, kleptoparasitism and feeding on or by shore.

§ Swimming and standing.

† Includes inter and intraspecific agonistic behaviour and courtship activities.

* For duration and the time scan samples collected see Appendix 3.

1 Data pooled from all sites and watches.

TABLE 25 Percent of Feeding and Loafing Trumpeter Swans Observed in Various Habitats at Each Site. From census data.

		% OF BIRDS							
		MARSH		TAGISH		TESLIN		LITTLE ATLIN	
	YEAR	Feed	Loaf	Feed	Loaf	Feed	Loaf	Feed	Loaf
Total Number of Birds	1982	241	142	67	41	53	24	3	18
	1983	627	175	142	78	129	49		
HABITAT TYPE									
Open Water	1982	81	23			19	13		
	1983	92				6	8		
<10 m from Ice	1982	19	46	82	24	81	67	67	56
	1983	8		100	24	42			
Ice	1982		31		51		21		44
	1983		100		76		35		
<10 m from Shore	1982			18	20			33	
	1983					52	57		
Shore	1982								
	1983								
Emergent Vegetation	1982								
	1983								
Islands	1982				5				
	1983								

observed in open water areas. For loafing, Trumpeter Swans showed a preference for ice, and for areas less than 10 m from ice. They also used open water areas and near-shore areas for loafing, and at Tagish, a few birds used islands for loafing.

Greater White-fronted Goose

This species occurred sporadically at the staging sites and in low abundance (Appendix 10 and 11). The species abundance represented <0.1% of the total waterbirds in 1982 and 1983. White-fronted Geese were counted at all sites except Teslin in 1982 and Little Atlin in 1983. The earliest recorded arrival of the species was similar between years: 25 April 1982 and 23 April 1983. The largest group counted was a group of 13 at Little Atlin Lake on 8 May 1932.

Mossop (1976) noted White-fronted Geese at the Teslin site on 23 April 1976 and Soper (1954) noted this species at Teslin and Marsh Lakes migrating among Canada Geese and Snow Geese. Milligan (1978) first observed White-fronted Geese at Marsh Lake outlet on 3 May 1978 as a group of two birds. His sightings of the species were few and similarly sporadic.

Snow Goose

The Snow Goose was a rare migrant in the study area representing <0.1% of the cumulative total of waterbirds in 1982 and 1983. In 1982 the species occurred at all sites but Tagish and the total tally was 12 birds (Appendix 10). In 1983 the species occurred only at Tagish (1 bird). The earliest noted arrival was 22 April 1982 at Little Atlin when 1 Snow Goose was counted amid a group of swans. Sightings at Teslin and Marsh occurred during May.

In 1977 a flock of 250 Snow Geese was noted at Tagish (Foothills Pipelines (Yukon) Ltd. 1977). Most other records report smaller group sizes of ten birds or less (Renewable Resources 1975; Milligan 1978).

Canada Goose

Canada Geese represented 1.5% and 1.6% of the cumulative total of waterbirds during 1982 and 1983 respectively. During 1982 this species occurred at all sites and represented 8.9% of the waterbirds counted at the Little Atlin site and <2% at the other sites (Appendix 4). No Canada Geese were noted at Little Atlin Lake outlet during 1983 (Appendix 5). During both years Canada Goose abundance fluctuated. In 1982 the occurrence of major peaks was not consistent between the sites (Figure 27). The timing of peak goose numbers occurred from 21 April to 8 May 1982 and 22 and 23 April in 1983. The number of Canada Geese counted at the Tagish and Little Atlin sites in 1982 exceeded the 1983 count while at the Marsh site, 1983 estimates exceeded 1982 estimates. Canada Geese were least represented at the Teslin site. Among all sites, the cumulative total of Canada Geese was similar between years.

Canada Goose arrival in the study area has usually been in mid-April (Foothills Pipelines (Yukon) Ltd. 1978; Milligan 1978). Other studies have also noted few or no Canada Geese at the Teslin site (Foothills Pipelines (Yukon) Ltd. 1977, 1978).

Green-winged Teal

The abundance and timing of occurrence in the study area of this species differed between the two years. Green-winged Teal was the most abundant waterbird species in 1982 representing 18.6% of the cumulative total of waterbirds (Appendix 4). In contrast, during 1983 the species represented 7.6% of the total waterbirds counted and was not the most abundant dabbling duck species (Appendix 5). Green-winged Teal total numbers were greatest at the Marsh and Tagish sites in 1982 and greatest at the Marsh and Teslin sites in 1983.

Green-winged Teal occurred earlier in 1983 (18 April) than in 1982 (26 April). Similarly the occurrence of peak Green-winged Teal numbers

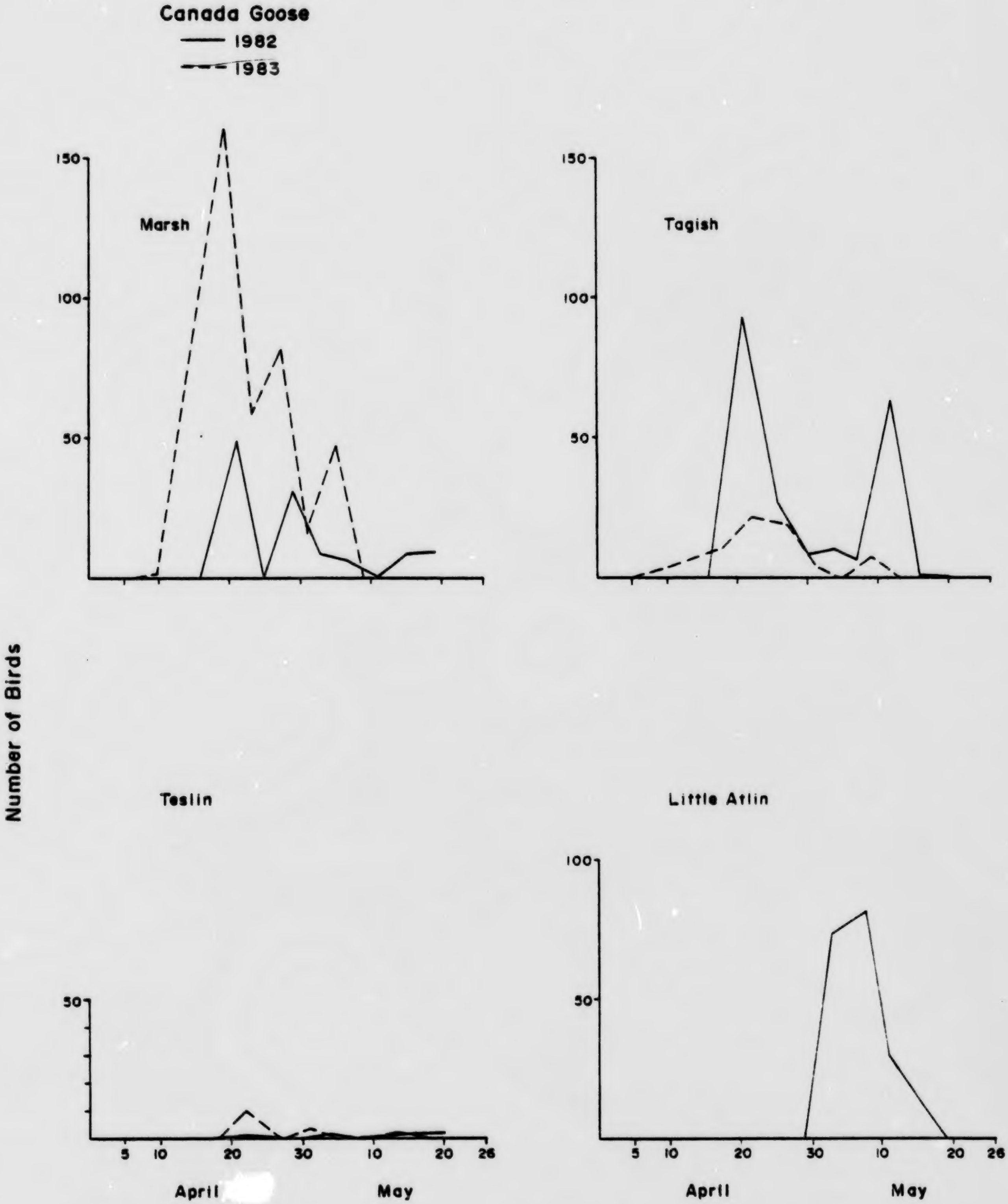


Figure 27 Number of Canada Geese Counted During Census Periods in 1982 and 1983.

at the three major sites was earlier in 1983 (1 May) than in 1982 (11 and 12 May). However the magnitude of peak abundance was greater at all sites in 1982, and was particularly great at the Tagish site (Figure 28). In 1983 all sites showed a decrease in Green-winged Teal abundance by late May. During 1982, teal numbers at the Marsh site had increased on 20 May, although all of the other sites showed a reduction in teal abundance.

The difference in the timing and relative sizes of the peaks in abundance of Green-winged Teal between the two years was likely a function of the lateness of spring thaw in 1982 and the availability of mudflats. During 1982 the atypically late spring thaw corresponded with a late waterbird migration.

Mudflats were exposed and more extensive on 9 May, 1982 than 26 April, 1983. However, the Teslin site had the most extensive, exposed mudflats in 1982, yet did not support the greatest number of teal. During both years, the peak use of the staging sites by Green-winged Teal corresponded to the emergence of mudflats.

Intensive behavioural observations conducted in 1982 indicated that Green-winged Teal spent a very large proportion of time feeding while in the study area; greater than any other duck species. Feeding comprised 90% of the activity budget at Teslin; 69% at Tagish; and 55% at Marsh (Table 26). In contrast, feeding comprised only 7% of the activity budget and loafing 93% at the Little Atlin site. Relative amounts of surface feeding versus sub-surface feeding were highly variable on different dates at the four sites; however, there was a greater proportion of sub-surface feeding overall.

Census data also indicated a high degree of feeding activity among Green-winged Teal. At the three main sites (Marsh, Tagish and Teslin) from 68% to 73% of Green-winged Teal observations involved feeding

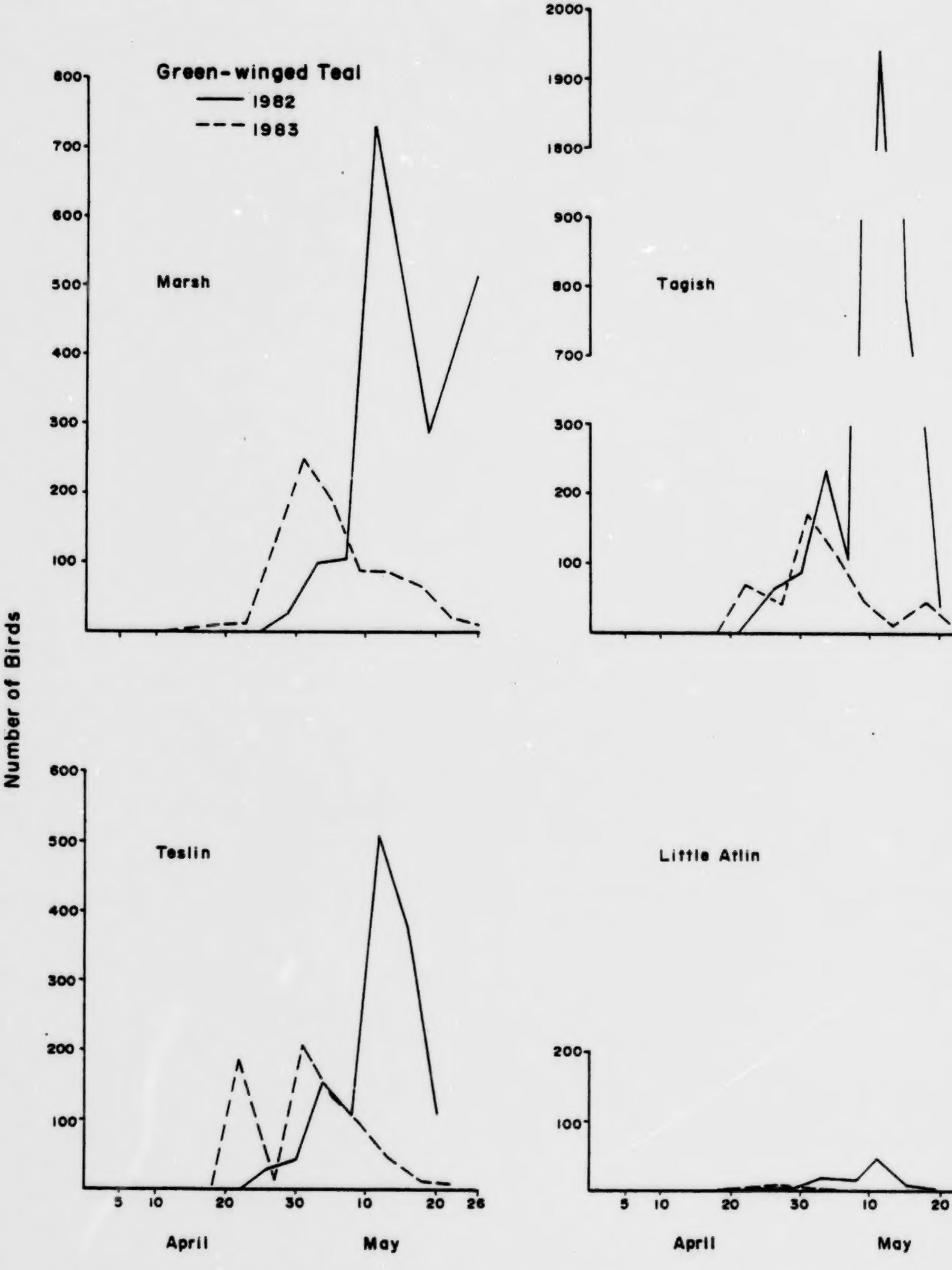


Figure 28 Number of Green-winged Teals Counted During Census Periods i
1982 and 1983.

TABLE 26 Activity Budget of Green-Winged Teal, Spring 1982. From intensive behaviour watches.

		ACTIVITIES, % TIME									
		LOAF				FEED[@]			OTHER		NO. 15 MINUTE SCAN SAMPLES[*]
LOCATION	DATE	AWAKE[§]	PREEN	SLEEP	TOTAL	SUB-SURFACE	SURFACE	TOTAL	AGONISTIC[†]	FLY	
Little Atlin	April 29	27.1	1.7	59.3	88.1		11.9	11.9			9
	May 3	17.0		83.0	100			0			11
	May 8	4.3	1.0	84.3	89.6	7.1	3.5	10.6			9
	Mean				**92.5**			**11.2**			
Teslin	April 30	7.7	2.6		10.3	51.3	38.4	89.7			8
	May 12	2.8	0.1	9.0	11.9	88.1		88.1			10
	May 16	0.3		4.5	4.8	58.0	35.1	93.1		2.1	11
	Mean				**9.0**			**90.3**			
Marsh	May 6	24.7	3.7	32.1	60.5	14.8	21.6	36.4	0.6	2.5	27
	May 14	8.7	1.7	15.6	26.0	59.3	14.7	74.0			17
	Mean				**43.2**			**55.2**			
Tagish	May 1	18.3		18.3	36.6	47.5	15.9	63.4			15
	May 9	9.2	0.4	16.0	25.6	18.7	55.7	74.4			13
	Mean				**31.1**			**68.9**			
All	**Mean**	**12.0**	**1.1**	**32.3**	**45.3**	**34.5**	**19.7**	**54.1**	**0.1**	**0.5**	**TOTAL**
Locations	**S.D.**	**9.3**	**1.3**	**31.8**	**36.3**	**30.3**	**18.4**	**36.2**	**0.2**	**1.0**	**130**

[@] Subsurface refers to feeding with head below water surface; surface feeding includes feeding on water surface, kleptoparasitism and feeding on or by shore.

[§] Swimming and standing.

[†] Includes inter and intraspecific agonistic behaviour and courtship activities.

[*] For duration and the time scan samples collected see Appendix 3.

1 Data posted from all sites and all watches.

birds in 1982, and from 76% to 85% involved feeding birds in 1983. Most of the remaining observations involved loafing birds. Only two birds (at Teslin in 1983) were observed in courtship behaviour during censuses.

Table 27 shows the percent use of various habitats by birds observed during census. At each of the three major sites, shore areas were used by the majority of Green-winged Teal observed feeding. The next most favoured habitat type for feeding was near shore area (< 10 m from shore). Open water areas were used very infrequently for feeding. Shore and near-shore areas were preferred for loafing. In 1982, ice and open water were used for loafing. At Little Atlin Lake, the few birds observed feeding were using emergent vegetation areas, and the majority of loafing birds used ice areas.

American Black Duck

This species is a rare visitor to the Yukon Territory. A common breeder in the Canadian southeast, the American Black Duck breeds as far west as Kelsey and Hanna, Alberta (Godfrey 1966). Salter et al (1974) sighted two Black Ducks along the Mackenzie River on 12 May 1973 and one adult was observed on the Old Crow Flats (Mossop and Hayes 1977).

During this study one American Black Duck was observed among a group of 7 Mallards at Tagish on 30 May 1982. No Black Ducks were noted during 1983.

Mallard

During both years the Mallard was the third most abundant dabbling duck species in the study area representing 13% of the cumulative total of waterbirds in 1982 (Appendix 4) and 11.4% in 1983 (Appendix 5). On

TABLE 27 Percent of Feeding and Loafing Green-winged Teal Observed in Various Habitats at Each Site. From census data.

		% OF BIRDS							
		MARSH		TAGISH		TESLIN		LITTLE ATLIN	
	YEAR	Feed	Loaf	Feed	Loaf	Feed	Loaf	Feed	Loaf
Total Number of Birds	1982	981	216	1892	274	850	327	8	91
	1983	658	142	460	80	547	170		
HABITAT TYPE									
Open Water	1982	2	2			1	9		
	1983	7	15	3	6	1	28		
<10 m from ice	1982	19	23	5	1	8	12		11
	1983	2		2	3				
Ice	1982	<1	31	27	22		17		73
	1983		11	1			1		
<10 m from Shore	1982	14	19	19	23	21	36		10
	1983	36	20	38	56	60	27		
Shore	1982	66	25	47	52	70	25		
	1983	54	53	55	35	39	44		
Emergent Vegetation	1982							100	7
	1983								
Islands	1982			1	2				
	1983								

the basis of cumulative totals, Mallards were more abundant in 1982 than in 1983.

The Mallard was equally abundant at the three major sites in 1982 and particularly abundant at the Tagish site in 1983 (Appendix 4 and 5). Mallards represented as much as 18% of the cumulative total of waterbirds counted at the Teslin site in 1982. The lowest Mallard representation among the three major sites was at the Marsh site in 1983 (7%).

The arrival of Mallards at the study area was earlier in 1983 than in 1982 (5 April versus 25 April). A major influx of migrants was noted on 18-19 April 1983 and 25-26 April 1982. Similarly the peak number of Mallards was earlier in 1983, occurring over 22 to 27 April among the sites and 3 to 19 May in 1982. Peak Mallard numbers were similar between the two years at the Marsh site, lower in 1983 at the Teslin site and noticeably higher in 1983 at the Tagish site (Figure 29). During both years, the largest peak was recorded at the Tagish site (784 birds in 1983 and 480 in 1982). By late May 1982, the abundance of Mallards decreased at all staging sites except Marsh Lake outlet. The late increase in Mallard abundance at the Marsh site during 1982 was coincidental to the breakup of the M'Clintock River which formed a delta of exposed bars and shallow waters in Marsh Lake outlet where many waterbirds fed. Increases in duck abundance were noted with many dabbling duck species in late May 1982.

The chronology of peak Mallard abundance corresponded to results from Milligan's study (1978) in the southern Yukon Territory. The peak numbers at the Marsh and Tagish sites in 1982 and 1983 were well above 1978 estimates (Milligan 1978).

During 1982, Mallards at the three main sites (Marsh, Teslin and Tagish) spent a third to a half of their time feeding and most of their

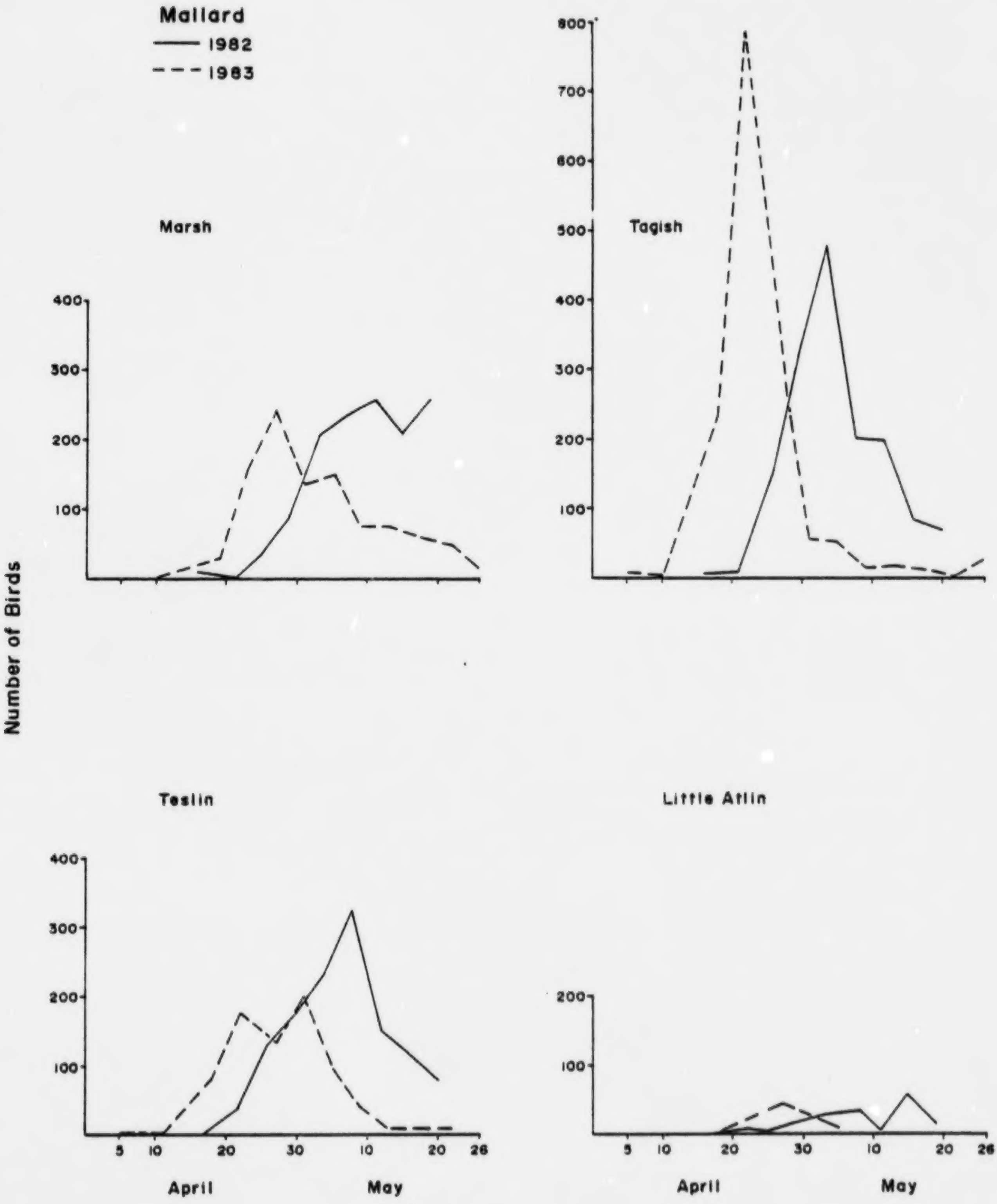


Figure 29 Number of Mallards Counted During Census Periods in 1982 and 1983.

remaining time loafing, based on intensive behaviour observations (Table 28). Although some surface feeding took place, most feeding was sub-surface. Other activities such as flying and agonistic behaviour, together made up only 1% of the activity budget. Some site differences in activity budgets were found. The percent of time spent feeding and loafing respectively was 35% and 64% at the Marsh site; 49% and 53% at the Tagish site; and 42% and 57% at the Teslin site. At the Little Atlin site, feeding comprised only 6% of the activity budget, and loafing 93%.

Table 29 gives the percentage of feeding birds and of loafing birds observed in various habitat types at the four sites. Preferred habitats for feeding at Marsh, Tagish and Teslin were areas < 10 m from shore and < 10 m from the ice-edge. Both these habitat types represented shallow water areas. In 1982, 93% of observations of feeding Mallards at Tagish were in these two habitats; and 84% at Marsh and 71% at Teslin were in these habitats.

The majority (72%) of feeding Mallards at the Little Atlin site were in areas of emergent vegetation. In 1983, 87% of feeding Mallards at Tagish were observed <10 m from shore or ice; and 67% at Teslin and 43% at Marsh were in these habitats. Open water and shore habitats were used by 31% and 26% respectively by feeding Mallards at the Marsh site in 1983. The shore habitat was used by 10% of feeding Mallards at Tagish in 1983; and at Teslin by 16% in 1982 and 13% in 1983. Open water areas were used by 11% or 12% of feeding Mallards at Marsh Lake and Teslin lake in 1982.

Preferred habitats for loafing were ice, shore, and areas < 10 m from shore. At each site, from 63% to 85% of loafing Mallards used these three habitat types in either year. Habitats used to a larger extent for loafing were open water and areas < 10 m from ice.

TABLE 28 Activity Budget of Mallard, Spring 1982. From intensive behaviour watches.

		ACTIVITIES, % TIME									
		LOAF				FEED@			OTHER		NO. 15 MINUTE SCAN SAMPLES*
LOCATION	DATE	AWAKE§	PREEN	SLEEP	TOTAL	SUB-SURFACE	SURFACE	TOTAL	AGONISTIC†	FLY	
Little Atlin	April 29	30.0	10.0	50.0	90.0	10.0		10.0			9
	May 3	34.0	8.5	53.2	95.7					4.3	13
	May 8		5.8	91.9	97.7		2.3	2.3			9
	May 11	40.0	10.0	36.7	86.7	13.3		13.3			8
	Mean				**92.5**			**6.4**			
Teslin	April 22	79.6	1.2	2.9	83.7	15.7	0.6	16.3			18
	April 26	66.7	9.5	4.8	81.0	19.0		19.0			9
	April 30	24.9	6.9	15.8	47.6	43.8	7.5	51.3	0.6	0.6	15
	May 12	2.3	6.1	18.3	26.7	72.6		72.6	0.8		10
	May 16	10.1	2.9	34.7	47.7	45.6	6.7	52.3			12
	Mean				**57.4**			**42.3**			
Marsh	April 28	89.3	0.7	3.0	93.0	2.7	2.7	5.4	1.0	0.7	28
	May 6	23.9	5.7	22.2	51.8	41.9	4.2	46.1	1.5	0.7	27
	May 14	17.0	7.9	22.3	47.0	51.5	0.5	52.0		1.0	17
	Mean				**63.9**			**34.5**			
Tagish	April 23	33.0	5.5	23.6	62.1	37.7		37.7	0.3		22
	May 1	23.8	1.7	12.3	37.8	26.1	35.0	61.1	1.1		16
	May 9	18.7	5.9	26.3	50.9	33.4	15.8	49.2			18
	Mean				**53.3**			**49.3**			
All Locations	**Mean**	**32.9**	**5.9**	**27.9**	**66.6**	**27.5**	**5.2**	**32.6**	**0.4**	**0.5**	**TOTAL**
	S.D.	**26.5**	**3.1**	**23.4**	**23.9**	**21.4**	**9.4**	**24.0**	**0.5**	**1.1**	**231**

@ Subsurface refers to feeding with head below water surface; surface feeding includes feeding on water surface, kleptoparasitism and feeding on or by shore.

§ Swimming and standing.

† Includes inter and intraspecific agonistic behaviour and courtship activities.

* For duration and the time scan samples collected see Appendix 3.

1 Data pooled from all sites and all watches.

TABLE 29 Percent of Feeding and Loafing Mallards Observed in Various Habitats at Each Site. From census data.

		% OF BIRDS							
		MARSH		TAGISH		TESLIN		LITTLE ATLIN	
	YEAR	Feed	Loaf	Feed	Loaf	Feed	Loaf	Feed	Loaf
Total Number of Birds	1982	497	677	682	628	666	495	29	126
	1983	597	306	941	450	312	413		
HABITAT TYPE									
Open Water	1982	11	17	3	6	12	13	7	2
	1983	31	19	3	18	5	11		
<10 m from Ice	1982	53	17	34	9	26	12	3	17
	1983	1		22	7		4		
Ice	1982	2	36	1	33	<1	24	7	56
	1983	<1	12		34	15	17		
<10 m from Shore	1982	31	8	59	21	45	19		14
	1983	42	21	65	41	67	30		
Shore	1982	3	19	2	27	16	25	10	
	1983	26	48	10		13	38		
Emergent Vegetation	1982							72	1
	1983			<1					
Islands	1982		2	1	2				
	1983								
Ice Pan	1982				1		6		
	1983								

During censuses, some courtship behaviour among Mallards was observed, but this never involved more than 1% of Mallards noted at any site. Nine birds were observed engaged in courtship behaviour at Teslin in 1982; and in 1983, courtship behaviour was observed for 6 birds at Tagish and 2 birds at Marsh.

Northern Pintail

The Northern Pintail was the most abundant waterbird species in 1983 and the third most abundant species in 1982. This species was represented at all staging sites, except the Little Atlin site in 1983. Northern Pintails were most abundant at the Marsh and Tagish sites (Appendix 4 and 5). Although more pintails were at the Marsh site than at Tagish during 1983, the Northern Pintail was the most abundant species at the Tagish site and represented 18.1% of the cumulative total of all waterbirds there. Similarly, the pintail was one of the more abundant waterbird species at the Teslin site in 1982.

In 1983 the timing of Northern Pintail arrival (11 April) and the peak in abundance (23-27 April) was earlier than in 1982 by seven days and 11 to 18 days, respectively. The magnitude of the peak abundance was greater in 1983 at Marsh (1,038 versus 457) and Tagish (666 versus 387) sites and less at the Teslin site (Figure 30). Northern Pintail abundance had subsided by late May in 1983 but in 1982, >200 birds remained at the Marsh site and >100 at the Teslin site.

Intensive behavioural observations conducted during 1982 indicated that Northern Pintails at the three major sites spent from 48% to 63% of their time engaged in feeding activity and almost all their remaining time loafing (Table 30). The highest proportion of time spent feeding (63%) was found at the Teslin site; while feeding comprised 48% of the activity budget of pintails at the Marsh site and 55% at the Tagish site. At Little Atlin, only 1% of the activity budget was composed of feeding activity; with loafing making up 98%.

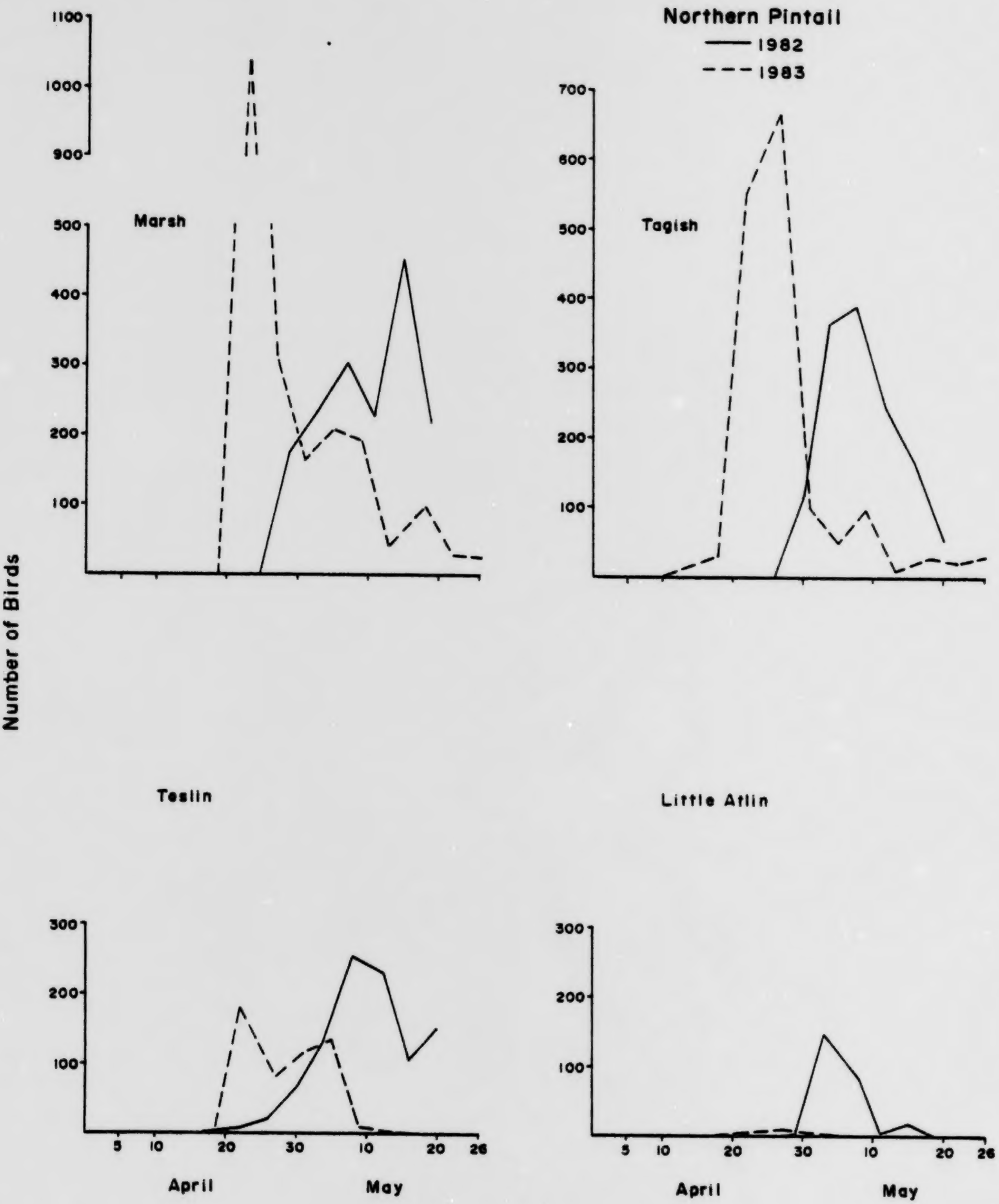


Figure 30 Number of Northern Pintails Counted During Census Periods in 1982 and 1983.

TABLE 30 Activity Budget of Northern Pintail, Spring 1982. From intensive behaviour watches.

		ACTIVITIES, % TIME									
		LOAF				FEED[#]			OTHER		NO. 15 MINUTE SCAN SAMPLES*
LOCATION	DATE	AWAKE[§]	PREEN	SLEEP	TOTAL	SUB-SURFACE	SURFACE	TOTAL	AGONISTIC[†]	FLY	
Little Atlin	April 29	15.2	12.1	69.7	97.0				3.0		9
	May 8	9.0	5.0	84.3	98.3	0.90	0.9	1.7			9
	Mean				**97.6**			**0.9**			
Teslin	April 26	7.0	3.5	27.5	38.0	62.0		62.0			9
	April 30	12.5	8.2	23.7	44.4	55.6		55.6			9
	May 12	9.7	6.8	12.5	29.2	70.8		70.8			10
	May 16	6.7	1.9	28.9	37.5	53.8	8.7	62.5			12
	Mean				**37.3**			**62.7**			
Marsh	April 25	70.7	0.7	26.4	97.8	0.8	1.4	2.2	0.1		30
	May 6	7.5	6.5	23.8	37.8	59.7	1.5	61.2	1.0		27
	May 14	10.5	2.3	7.0	19.8	80.2		80.2			17
	Mean				**51.8**			**47.9**			
Tagish	April 23	15.2	1.5	3.8	20.5	77.2		77.2	2.3		11
	May 1	51.7		15.2	66.9	25.2	6.7	31.9		1.2	25
	May 9	29.7	1.3	13.7	44.7	51.6	3.7	55.3			25
	Mean				**44.1**			**54.8**			
All Locations	**Mean**	**20.4**	**4.2**	**28.0**	**52.7**	**48.9**	**1.9**	**46.7**	**0.5**	**0.1**	**TOTAL**
	S.D.	**20.0**	**3.6**	**24.5**	**29.8**	**27.9**	**2.9**	**30.0**	**1.0**	**0.3**	**193**

[#] Subsurface refers to feeding with head below water surface; surface feeding includes feeding on water surface, kleptoparasitism and feeding on or by shore.

[§] Swimming and standing.

[†] Includes inter and intraspecific agonistic behaviour and courtship activities.

[*] For duration and the time scan samples collected see Appendix 3.

1 Data pooled from all sites and all watches.

Census data for 1982 showed similar results with respect to the proportion of birds feeding and loafing. Over all sites (summing all observations), roughly equal numbers of observations involved feeding and loafing birds. In 1983, however, observations involving feeding birds increased to 75%; and those involving loafing birds decreased to 24%. The greatest increase in feeding activity occurred at Marsh Lake: 83% of observations in 1983, compared with 51% in 1982. The percent of pintails observed feeding at Tagish Lake went from 41% in 1982 to 64% in 1983; and stayed about the same (64% to 65%) at Teslin Lake. The change between years in the proportion of birds feeding at Marsh Lake and Tagish Lake suggests that these sites served a greater role as feeding areas for this species in 1983 than in 1982.

At the Tagish site and particularly at the Marsh site, Northern Pintails were more abundant in 1983 than in 1982 and arrival of migrants to these sites was earlier in 1983. An increase in the use of Marsh and Tagish as staging/feeding areas in 1983 may have resulted from the earlier arrival of birds and their possible longer duration of stay at these sites; and/or from a greater availability of feeding habitat resulting from an earlier ice breakup and lesser amounts of near-shore ice.

A small percentage (<1%) of Northern Pintails were observed in courtship behaviour. This included two birds at each of the Marsh, Tagish and Teslin sites in 1982, and 7 birds at Tagish in 1983.

Table 31 shows the frequency of observations of feeding Northern Pintails in different habitat types and of loafing pintails in different habitats. Areas <10 m from shore (shallow water areas) were the preferred habitat for feeding at the three major sites. Over the two years, 63% of observations of feeding pintails at Tagish were in this near-shore habitat; 52% were in this habitat at Teslin; and 29% at Marsh Lake. Other habitats often used for feeding were shore areas, open water areas, and in 1982, areas within 10 m of ice. At the Marsh

TABLE 31 Percent of Feeding and Loafing Northern Pintails Observed in Various Habitats at Each Site. From census data.

		% OF BIRDS							
		MARSH		TAGISH		TESLIN		LITTLE ATLIN	
	YEAR	Feed	Loaf	Feed	Loaf	Feed	Loaf	Feed	Loaf
Total Number of Birds	1982	810	758	534	638	608	348	28	205
	1983	1738	319	748	411	329	169		
HABITAT TYPE									
Open Water	1982	23	21	18	3	17	14		
	1983	66	34	10	27	16	15		
<10 m from Ice	1982	33	13	14	5	9	3		3
	1983	1		4	2	1	1		
Ice	1982	1	44		55	<1	20		76
	1983		14		12		3		
<10 m from Shore	1982	41	4	61	13	46	34		14
	1983	23	24	64	25	63	30		
Shore	1982	1	13	6	20	29	25		
	1983	10	29	22	34	20	50		
Emergent Vegetation	1982							100	6
	1983								
Islands	1982		5	<1	4		3		
	1983								
Ice Pan	1982						1		
	1983								

site, 66% of feeding pintail observations in 1983 were in open water areas; and in 1982, 33% were made in areas <10 m from ice. Shore areas were used at Teslin by 29% of feeding pintails in the 1982 census and by 20% in 1983, and by 22% of feeding pintails at Tagish in 1983. At Little Atlin, all feeding pintails (28 birds) were observed in areas of emergent vegetation.

Areas of ice were preferred for loafing by the majority of pintails in 1982. At Marsh, Tagish, Teslin and Little Atlin, 44%, 55%, 20% and 76%, respectively, of observations of loafing birds were made on ice areas. In 1983, however, ice and areas near ice were used much less frequently. Other habitats used for loafing were shore areas (up to 50% of loafing birds at Teslin in 1983), areas < 10 m from shore, and open water areas.

Blue-winged Teal

This species was not abundant during either of the years. In 1982 Blue-winged Teal represented <0.1% of the cumulative waterbird total and 0.1% in 1983. During both years the species was not noted until mid to late May. Group size was usually small, (<10 birds) and the species did not occur at all of the sites during either of the study years (Appendix 10 and 11).

A total of 314 Blue-winged Teal was noted at Tagish on 5 May 1978 (Milligan 1978). Anweiler and Blood (1981) reported this species presence in low numbers at Marsh Lake outlet in 1980.

Cinnamon Teal

This species was rare in the study area. None were counted during 1982. In 1983, 2 were counted at the Marsh site on 18 May and a maximum of 2 were counted at the Tagish site from 18 to 26 May (Appendix 11).

The occurrence of Cinnamon Teal at the spring staging sites has not been documented in previous reports.

Northern Shoveler

The Northern Shoveler was not abundant in the study area. In 1982 it represented 1.2% of the waterbird total and 1.7% of the total in 1983. The time of arrival, late April, was similar between the two years, although the chronology of peak migration differed (Figure 31). Peak migration occurred earlier in 1983, from 5 to 9 May compared to 15 May in 1982. However, the Tagish site was an exception, as the date of peak migration was similar between years, 12 May 1982 and 13 May 1983. The amplitude of peak migration was similar between years at Marsh, greater in 1982 (98 versus 41) at Tagish and greater in 1983 (62 versus 27) at Teslin. Shoveler numbers had declined by 26 May in 1983 and had declined at all sites but Marsh by 19 May 1982. Few Northern Shovelers were counted at the Little Atlin site.

The dates of arrival are comparable with 1978 (Milligan 1978) and 1980 (Canadian Wildlife Service unpubl. data) results.

Eurasian Wigeon

The Eurasian Wigeon is not known to breed in North America but is a regular visitor to both coasts (Bellrose 1976). It was a rare species to the study area. During 1982, one was counted at the Teslin site and one at the Tagish site, on 4 May and 7 May respectively. During 1983, the only sighting was of 2 birds at the Teslin site on 1 May.

American Wigeon

The second most abundant species in 1982 and third most abundant in 1983, this species represented 15.5% of the cumulative total of waterbirds in 1982 (Appendix 4) and 13.2% in 1983 (Appendix 5). The

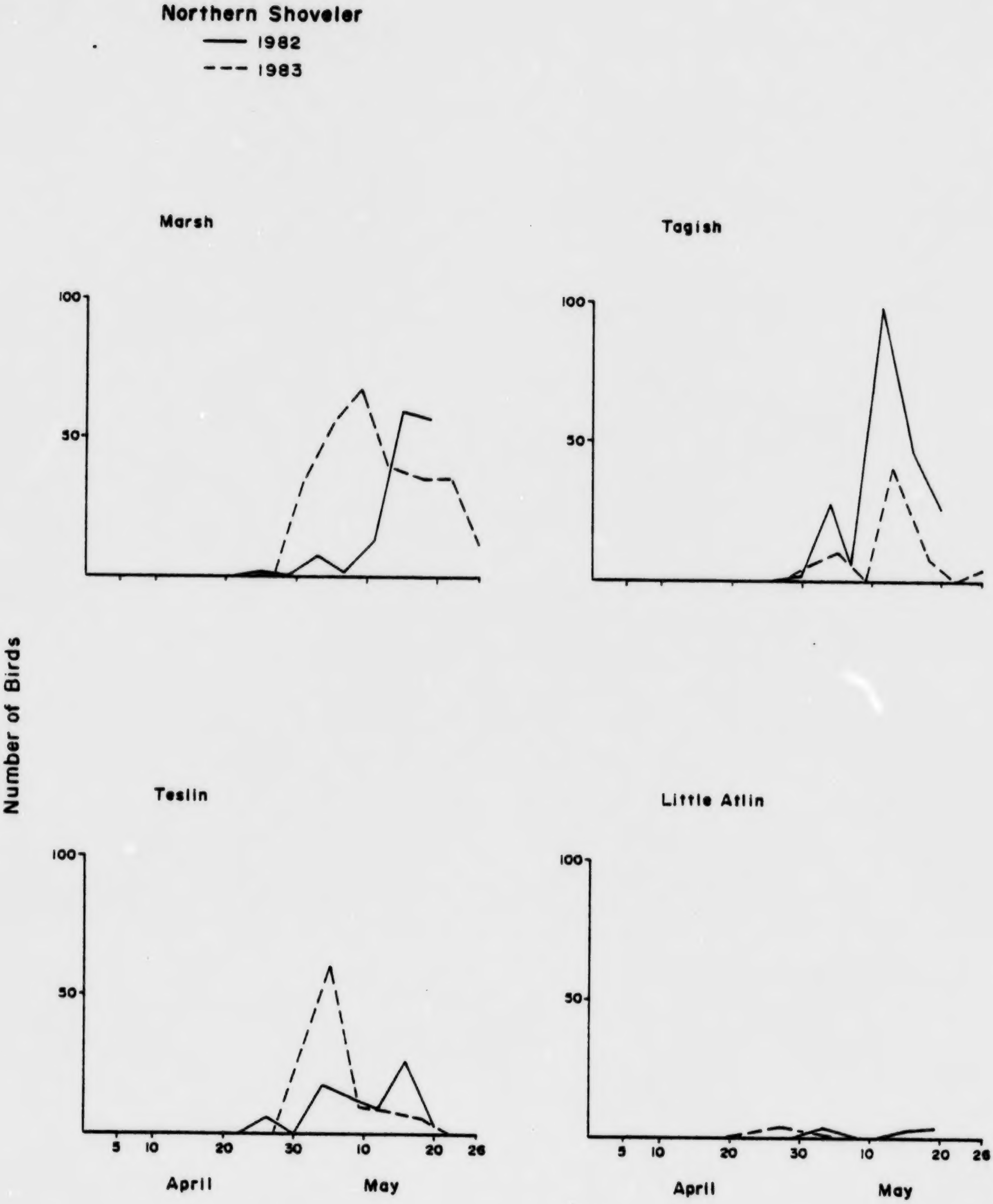


Figure 31 Number of Northern Shovelers Counted During Census Periods in 1982 and 1983.

total cumulative number of American Wigeons counted was greater in 1982 (4,976) than in 1983 (3,725). Wigeons were most abundant at the Tagish site in 1982 and most abundant at the Marsh site in 1983.

The earliest record of arrival was 18 April 1983, one week earlier than in 1982. Correspondingly, peak wigeon abundance occurred earlier in 1983, on 1 May, 10 days earlier than in 1982 (Figure 32). Peak American Wigeon abundance was greater at all sites in 1982 than in 1983. The date of arrival in 1983 compares with other years (Milligan 1978; CWS unpubl. data). However the peak abundance noted in 1982 at the sites exceeded estimates of 1978 (Milligan 1978) and 1980 (CWS unpubl. data).

During intensive behavioural observations at each of the four study area sites, from 36% to 42% of American Wigeon observations involved feeding birds (58% to 64% involved loafing birds) (Table 32). This was the only common duck species that used the Little Atlin site more for feeding than for loafing; other species used the site predominantly for loafing. At Tagish, most of the observed feeding was surface, while at the other three sites most feeding was sub-surface.

The activity of American Wigeon observed during census was balanced more towards feeding. Over all sites, 64% of wigeon observations involved feeding birds in 1982 and 73% involved feeding birds in 1983. The censuses were mainly conducted during the morning,

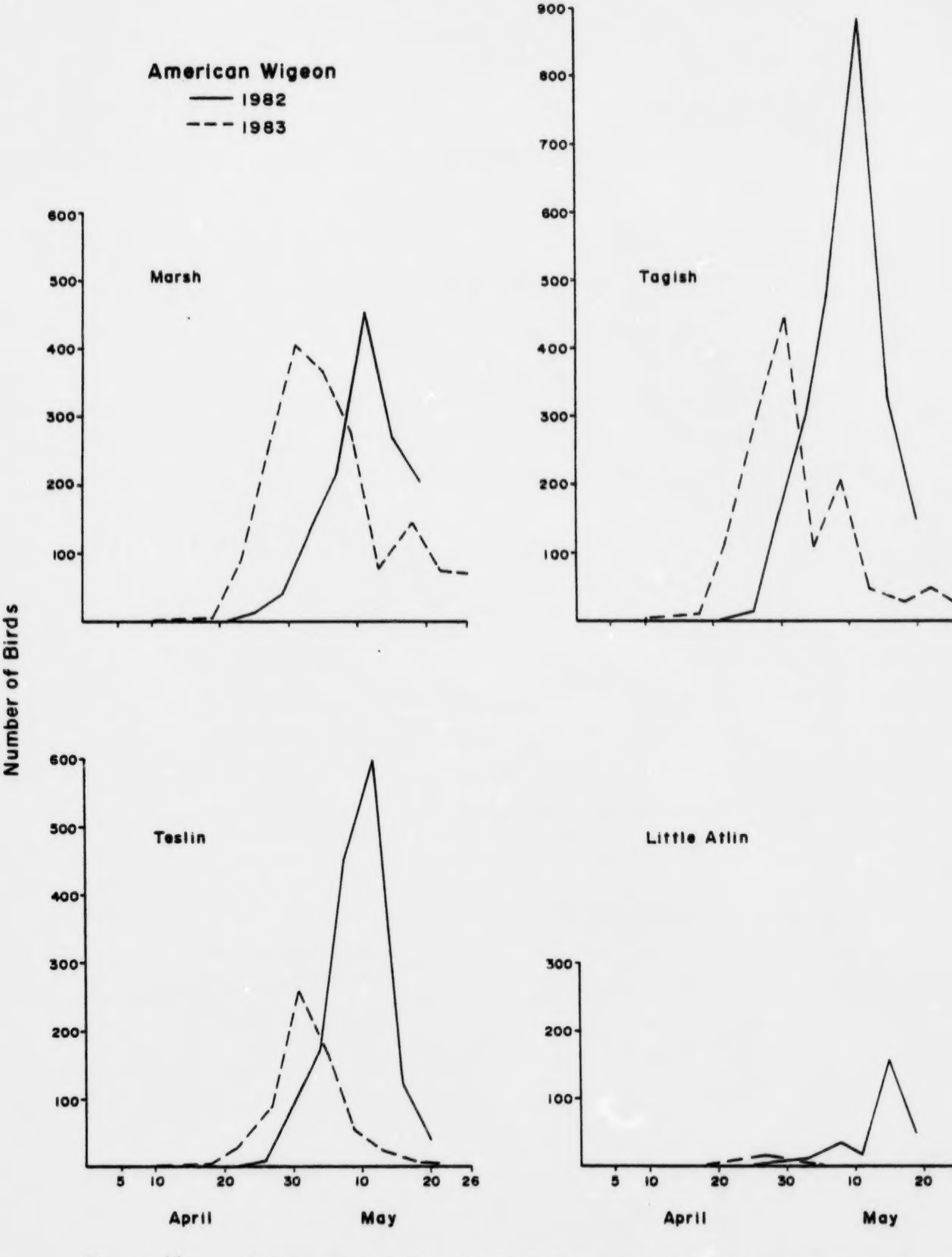


Figure 32 Number of American Wigeons Counted During Census Periods in 19
and 1983.

TABLE 32 Activity Budget of American Wigeon, Spring 1982. From intensive behaviour watches.

		ACTIVITIES, % TIME									
		LOAF				FEED[@]			OTHER		NO. 15 MINUTE SCAN SAMPLES*
LOCATION	DATE	AWAKE[§]	PREEN	SLEEP	TOTAL	SUB-SURFACE	SURFACE	TOTAL	AGONISTIC[†]	FLY	
Little Atlin	April 29	4.4		53.3	57.7		42.2	42.2			9
	May 3	33.3		16.7	50.0	50.0		50.0			6
	May 8	34.2	8.8	22.3	65.0	23.4	10.2	33.6	1.4		9
	Mean				**57.6**			**41.9**			
Teslin	April 30	30.4	13.9	16.5	60.8	31.9	6.4	38.4	0.8		9
	May 12	11.2	12.2	27.8	51.3	48.7		48.7			10
	May 16	64.0	0.9	14.5	79.4	15.4	5.3	20.6			12
	Mean				**63.8**			**35.9**			
Marsh	April 28	96.9	0.6	0.3	97.8	0.3	1.9	2.2			29
	May 6	37.7	6.8	8.7	53.2	20.2	26.6	46.8			27
	May 14	21.2	5.3	4.3	30.8	59.1	10.1	69.2			17
	Mean				**60.6**			**39.4**			
Tagish	April 23	70.0		10.0	80.0	10.0		10.0		10.0	4
	May 1	40.3	1.3		41.6	14.0	44.4	58.4			15
	May 9	22.0	1.6	33.3	56.9	7.4	25.6	43.0	0.1		25
	Mean				**59.5**			**37.1**			
All Locations	**Mean**	**38.8**	**4.2**	**17.3**	**60.4**	**23.4**	**14.4**	**38.6**	**0.2**	**1.1**	**TOTAL**
	S.D.	**26.4**	**5.0**	**15.3**	**18.2**	**19.9**	**16.3**	**91.4**	**0.4**	**3.3**	**172**

@ Subsurface refers to feeding with head below water surface; surface feeding includes feeding on water surface, kleptoparasitism and feeding on or by shore.

§ Swimming and standing.

† Includes inter and intraspecific agonistic behaviour and courtship activities.

* For duration and the time scan samples collected see Appendix 3.

1 Data pooled from all sites and all watches.

which may have been a time of higher feeding activity for the species. Observers noted courtship behaviour by 12 birds at Tagish in 1982, and by 5 birds (at Tagish and Teslin) in 1983.

Table 33 presents habitat use of birds observed during census. In 1982 and 1983, areas within 10 m of shore, and the shore areas themselves were the preferred habitats for feeding at Tagish and Teslin. Open water areas and areas within 10 m of ice were also used to some extent. At the Marsh site, open water areas were used most frequently for feeding. About half the wigeons observed feeding at Marsh Lake were using open water areas in each year. At Little Atlin, 88% of wigeons observed feeding were in emergent vegetation areas, and 12% were in areas of ice.

American Wigeon used a variety of habitats for loafing. Open water areas, areas < 10 m from shore, and shore areas were favoured. Ice was used for loafing in 32% of observations at Little Atlin, and with less frequency at other sites.

Areas within 10 m of ice were often used for loafing at Marsh in 1982. Islands were infrequently used for loafing ($\leq$ 1% of wigeon observations) at Marsh, Tagish and Teslin.

Canvasback

This species was one of the two most abundant diving duck species in 1982 and 1983 (Appendix 4 and 5). The arrival date was similar between years: 15 April 1982 and 18 April 1983. However more Canvasback were present on arrival in 1983 than in 1982 and peak migration was earlier in 1983 (Figure 33). Two peaks occurred in 1983 with the major peak on 5 May. Only one peak was noted at Tagish on 1

TABLE 33 Percent of Feeding and Loafing American Wigeons Observed in Various Habitats at Each Site. From census data.

		% OF BIRDS							
		MARSH		TAGISH		TESLIN		LITTLE ATLIN	
	YEAR	Feed	Loaf	Feed	Loaf	Feed	Loaf	Feed	Loaf
Total Number of Birds	1982	792	453	1178	823	1045	428	179	96
	1983	1169	325	972	252	369	233		
HABITAT TYPE									
Open Water	1982	52	31	10	27	9	30		
	1983	48	36	7	33	24	18		
<10 m from Ice	1982	17	31	16	4	7	7	12	33
	1983	<1	<1	<1	<1	4	1		
Ice	1982	<1	13	6	3		16		32
	1983	1	6		10	<1	6		
<10 m from Shore	1982	27	13	37	23	39	33		21
	1983	29	43	49	37	57	56		
Shore	1982	5	10	31	43	44	12		
	1983	22	14	43	19	14	21		
Emergent Vegetation	1982							88	14
	1983								
Islands	1982		1		<1	<1	<1		
	1983								
Ice Pan	1982						<1		
	1983								

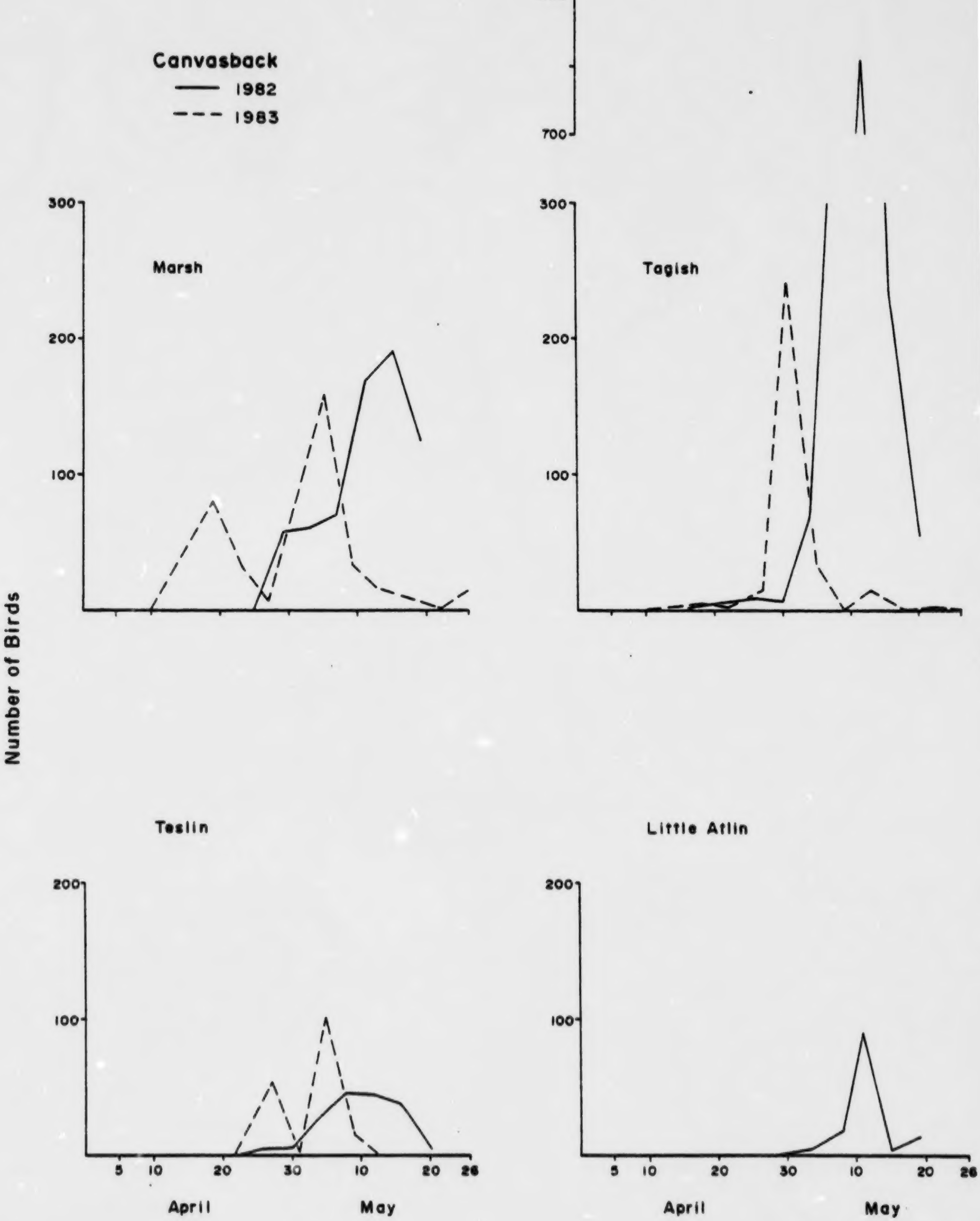


Figure 33 Number of Canvasbacks Counted During Census Periods in 1982 and 1983.

May, when the largest peak of 240 Canvasback occurred. The largest 1982 peak, also at Tagish, was appreciably higher on 12 May. Among all sites in 1982, Canvasback comprised the greatest proportion of total waterbirds at Tagish (Appendix 4). Representation in 1983 was similar between the major sites (Appendix 5). By late May of both years, Canvasback numbers had substantially declined. Marsh Lake outlet was the only site with more than 100 Canvasback.

Peak Canvasback numbers observed during 1982 were higher than in 1978 (Milligan 1978) and 1980 (CWS unpubl. data). No Canvasback were recorded in the study area in 1977 (Foothills Pipelines (Yukon) Ltd. 1977).

Intensive behavioural observations were not made on Canvasback, therefore an activity budget was not determined for this species. During censuses, more Canvasback were observed loafing than were observed feeding in 1982 (74% loafing versus 23% feeding), and in 1983 the reverse was true (37% loafing versus 61% feeding). The data on activity are highly variable among sites and between years and were probably a poor indication of the actual proportions of feeding and loafing activity. Nonetheless, relatively high rates of feeding activity were observed in 1983 at Marsh Lake (58% of Canvasback observations) and at Tagish (88% of Canvasback observations). Five birds were observed in courtship activity (at Tagish and Little Atlin) in 1982.

The preponderance of feeding activity occurred in open water areas (Table 34). Areas < 10 m from shore were used by up to 18% of the birds observed feeding at any site. At Teslin, in 1983, 93% of feeding Canvasback were observed feeding < 10 m from ice, whereas 91% were feeding in open water areas in 1982 at this site.

Open water areas were used for loafing. At the three major sites during 1982 and 1983, from 66% to 82% of loafing birds were

TABLE 34 Percent of Feeding and Loafing Canvasbacks Observed in Various Habitats at Each Site. From census data.

		% OF BIRDS							
		MARSH		TAGISH		TESLIN		LITTLE ATLIN	
	YEAR	Feed	Loaf	Feed	Loaf	Feed	Loaf	Feed	Loaf
Total Number of Birds	1982	138	525	333	979	47	124	32	102
	1983	249	167	254	35	46	128		
HABITAT TYPE									
Open Water	1982	93	82	78	81	91	79		
	1983	88	91	97	66	2	77		
<10 m from Ice	1982	6	11	4	8	9	3	100	73
	1983				17	93			
Ice	1982		<1		<1		<1		12
	1983						9		
<10 m from Shore	1982	1	7	18	10		17		16
	1983	12	9	3	17	4	7		
Shore	1982				<1				
	1983						7		

observed in open water areas. The majority (73%) of loafing birds observed at Little Atlin were using areas within 10 m of ice.

Redhead

This species was not abundant during either study year. The cumulative total number in 1982 (87) was greater than in 1983 (33). The Redhead was an early migrant to the study area, first noted in 1982 on 22 April and on 11 April in 1983 (Appendix 10 and 11). Most of the birds occurred at the Marsh and Tagish sites during 1982 and at the Marsh site during 1983. Redheads were noted in the study area up until late May during both years.

Milligan (1978) first noted Redheads on 20 April at Marsh Lake outlet. He counted 11 during the April study. Two were counted at the Marsh site on 19 April 1980 (CWS unpubl. data).

Ring-necked Duck

The Ring-necked Duck was not an abundant species at the staging sites, representing 0.3% of the total waterbirds in 1982 and 0.5% in 1983. Although this species arrived in mid April, most of the Ring-necked Ducks in 1982 did not occur until 7 to 20 May at the four sites (Appendix 10). Ring-necked Ducks were most abundant at Little Atlin Lake in 1982, although none were recorded there during three visits in 1983. In 1983, this species used the Marsh site most continuously during the survey period and was also most abundant at this site.

Scaup spp.

Although both species, Greater Scaup (_A. marila_) and Lesser Scaup (_A. affinis_) may have occurred in the study area, most birds were presumably the latter. Scaup was the most abundant diving duck during both study years. More Scaup were counted during 1982, when they represented 6.4% of the total waterbirds at all sites, ranging from 3.9% to 10.8% at individual sites (Appendix 4). Peak migration was ten days earlier in 1983 than in 1982, occurring on 5 May.

The amplitude of the peak was greater in 1982 when 502 Scaup were observed at Tagish in contrast to the peak number of 208 counted at Marsh in 1983. Scaup were most abundant at Tagish in 1982 and most abundant at Marsh in 1983 (Figure 34). By 26 May 1983 Scaup numbers had declined to less than 30 birds at all sites. Scaup migration was not over by 20 May in 1982 as at least 100 birds were present at all sites.

Intensive behavioural observations were not conducted on scaup, hence an activity budget was not determined for the species. During censuses, approximately equal numbers of feeding and loafing scaup were observed in 1982, while in 1983, 31% of scaup observed were feeding and 67% were loafing. The greatest number of scaup were observed at Tagish in 1982, where 67% of observations involved feeding birds. Courtship behaviour was observed by 17 birds at Marsh and 6 at Tagish.

Table 35 shows the habitat useage of birds observed during censuses. Feeding activity occurred mainly in open water areas. More than 90% of scaup observed feeding at the Tagish and Teslin sites in both years and at Marsh in 1982 were using open water areas. At Marsh in 1983, 20% of scaup observed feeding were using shore areas and 13% were in near-shore (< 10 m from shore) areas. Loafing birds were

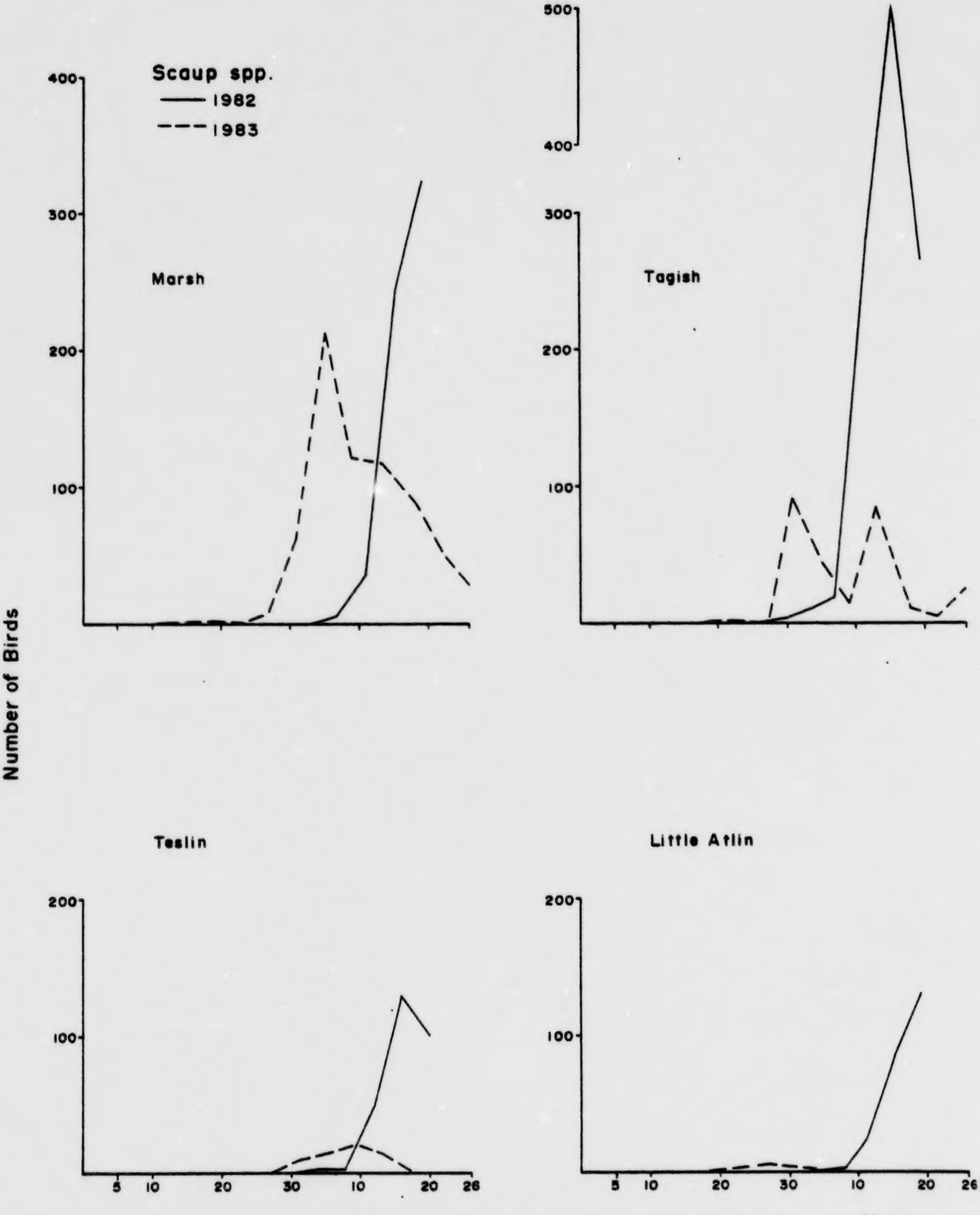


Figure 34 Number of Scaup Counted During Census Periods in 1982 and 1983

TABLE 35 Percent of Feeding and Loafing Scaup Observed in Various Habitats at Each Site. From census data.

		% OF BIRDS							
		MARSH		TAGISH		TESLIN		LITTLE ATLIN	
	YEAR	Feed	Loaf	Feed	Loaf	Feed	Loaf	Feed	Loaf
Total Number of Birds	1982	191	369	723	351	134	148	41	201
	1983	201	434	65	155	26	38		
HABITAT TYPE									
Open Water	1982	94	77	93	18	99	47	27	
	1983	66	80	94	90	92	50		
<10 m from Ice	1982	3	5	1	1		4	73	84
	1983								
Ice	1982								3
	1983								
<10 m from Shore	1982		18	6	80	1	49		11
	1983	13	14	6	10	8	50		
Shore	1982	3			1				
	1983	20	6						
Emergent Vegetation	1982								2
	1983								

mainly observed in open water areas at Marsh, while at Tagish and Teslin, they preferred both open water areas and areas within 10 m of shore.

Harlequin Duck

This was a rare species in the study area. Harlequin Ducks were only observed in 1982 and only at the Tagish site. Two pairs were counted on 16 May and one pair on 20 May (Appendix 10). Although not a common or abundant migrant through the study area, Tagish residents have documented its occurrence (Renewable Resources 1975).

Oldsquaw

The Oldsquaw was a rare migrant to the study area. No Oldsquaw were observed during 1982. On one occasion in 1983, a group of 25 birds were counted in open water in zone 7, at the Marsh site on 22 May. Most of the previous waterfowl spring staging studies have terminated during or before early May, prior to Oldsquaw migration. This could explain the reason for this species absence in the records,although it is doubtful the species is ever abundant at the staging sites in the spring.

Surf Scoter

A species noted in comparatively low numbers in the study area, the Surf Scoter represented 0.4% of the total waterbirds counted in 1982 and 1.0% of the total in 1983. This species was a late migrant. First sightings occurred on 11 May in 1982 and 5 May in 1983. Surf Scoters were counted at all sites in 1982 and at all sites except Little Atlin Lake during 1983. The greatest cumulative total of Surf Scoters was noted at the Marsh site in 1982 (Appendix 10), and at the Tagish site in 1983 (Appendix 11). Peak numbers were observed at similar times between years, 20 May in 1982 and between 18-22 May in 1983.

White-winged Scoter

This species was less abundant at the staging sites than Surf Scoter. In 1982 White-winged Scoter represented 0.1% of the cumulative total of waterbirds and 0.2% in 1983. Also a late migrant, first observations of this species occurred on 11 May 1982 and 13 May 1983. This species was ubiquitous at the four staging sites in 1982, yet was counted only at the Marsh and Tagish sites during 1983. Peak numbers (25) were noted on 19 May in 1982 and 13 May 1983 at the Marsh site (Appendix 10 and 11). Although still present at the sites up to the end of the survey, White-winged Scoters cumulatively totalled 6 birds on 26 May 1983 and 31 birds on 20 May 1982.

Common Goldeneye

This species was one of the more common diving duck species at the staging sites representing 4.6% of the cumulative total of all waterbirds in 1982 and 2.7% in 1983. During both study years Common Goldeneye were counted at the sites on the initial surveys. In mild winters, goldeneye may overwinter at the sites (Mossop 1976). Represented at all sites except Little Atlin Lake during 1983, the species remained in the study area during 1982 until 20 May. During 1983, most of the birds were gone from the areas by 9 May (Figure 35). The chronology of peak bird numbers tended to overlap between the two years at a given site. Peak numbers occurred from late April to early May at the Teslin and Marsh sites. At the Tagish site where the largest peaks were noted during both years, peak migration (784 birds) occurred on 22 April in 1983, 12 days earlier than in 1982 when a smaller peak (184 birds) was noted. Common Goldeneye was the most common diver species at the Teslin site during 1982 and at the Tagish site during 1983. Few Common Goldeneye were counted at the Little Atlin site.

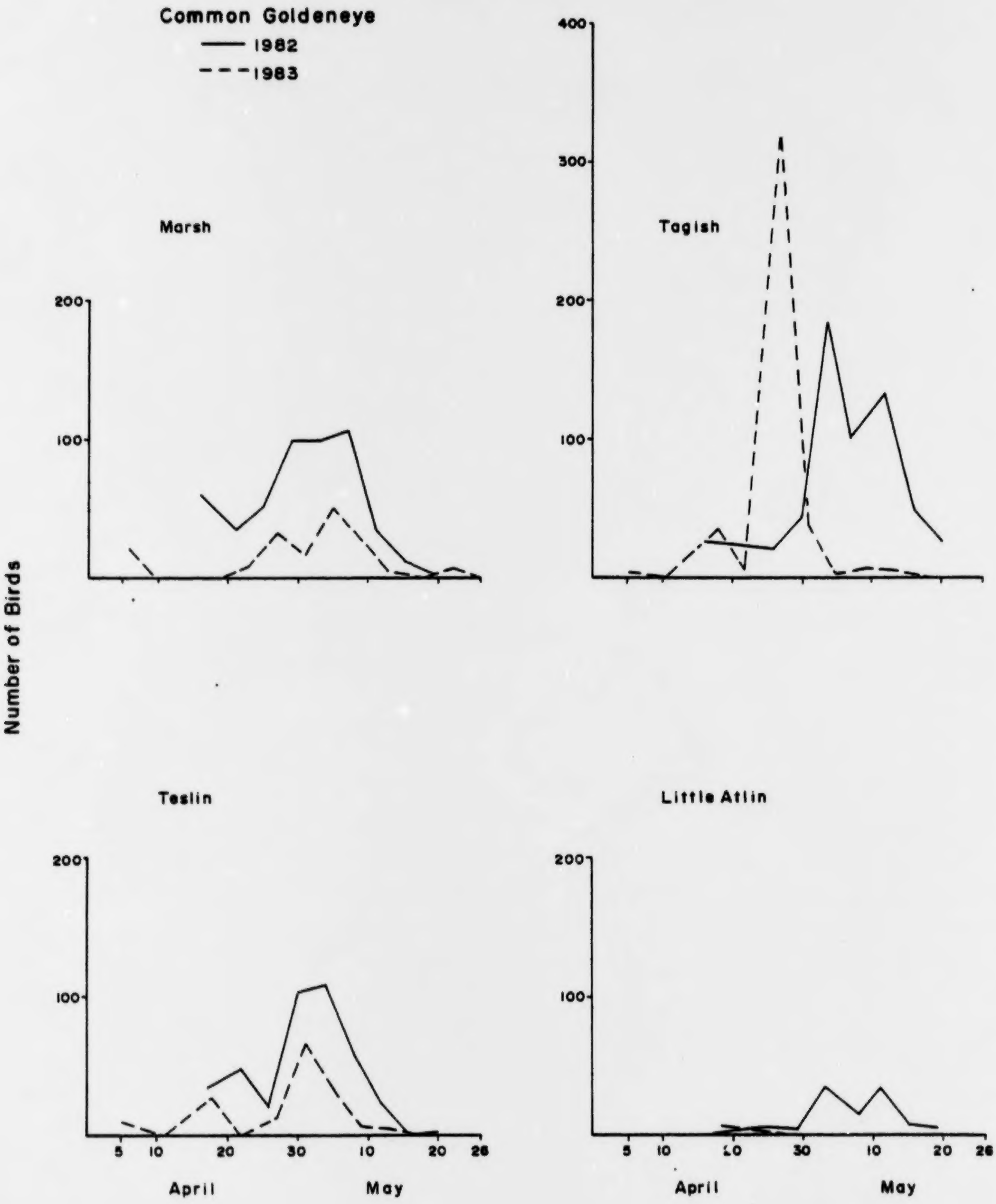


Figure 35 Number of Common Goldeneye Counted During Census Periods in 1982 and 1983.

Barrow's Goldeneye

Barrow's Goldeneye was not as abundant as Common Goldeneye and arrived in the study area later. Arrival was noted on 10 April 1983, seven days earlier than in 1982. In 1982, although one Barrow's Goldeneye was counted on 17 April, the initial influx was not noted until 25 April (Figure 36). The migration peak in 1982 occurred on 7 May at the Marsh and Little Atlin sites and 16 May at the Tagish site. Peak migration was earlier during 1983 but varied between the sites. During 1983 there were more Barrow's Goldeneye counted at the Marsh and Teslin sites than in 1982 and less counted at the Tagish and Little Atlin sites. This species was the most abundant diver species at Little Atlin Lake during 1982 (Appendix 4) yet none were counted there during 1983.

Bufflehead

Bufflehead comprised 2.7% of the cumulative total of waterbirds in 1982 and 2.4% in 1983. Within both years this species was counted at all of the sites, except Little Atlin Lake in 1983. Bufflehead represented 10.1% of the total waterbirds counted in 1982 at the Little Atlin site, yet represented no more than 3% at all other sites. In 1982 Bufflehead were noted on 16 April at the Tagish site although it was not until 30 April that the species was noted at all sites (Figure 37). The first sightings of Bufflehead in 1983 were on 18 and 19 April at the Little Atlin and Marsh sites, respectively. The time of peak Bufflehead numbers varied between sites and between years. Generally peak numbers in 1982 occurred later than those observed in 1983. Peak Bufflehead numbers at the Tagish and Teslin sites occurred on 27 April 1983, 6 days earlier than in 1982, yet peak numbers were less in 1983.

At the Marsh site the timing of peak Bufflehead migration during the two years was similar (3 to 5 May) yet the peak abundance was larger in 1983. Two peaks were noted at the Marsh site in 1983; the first and smaller peak occurred on 27 April, coincident with peak

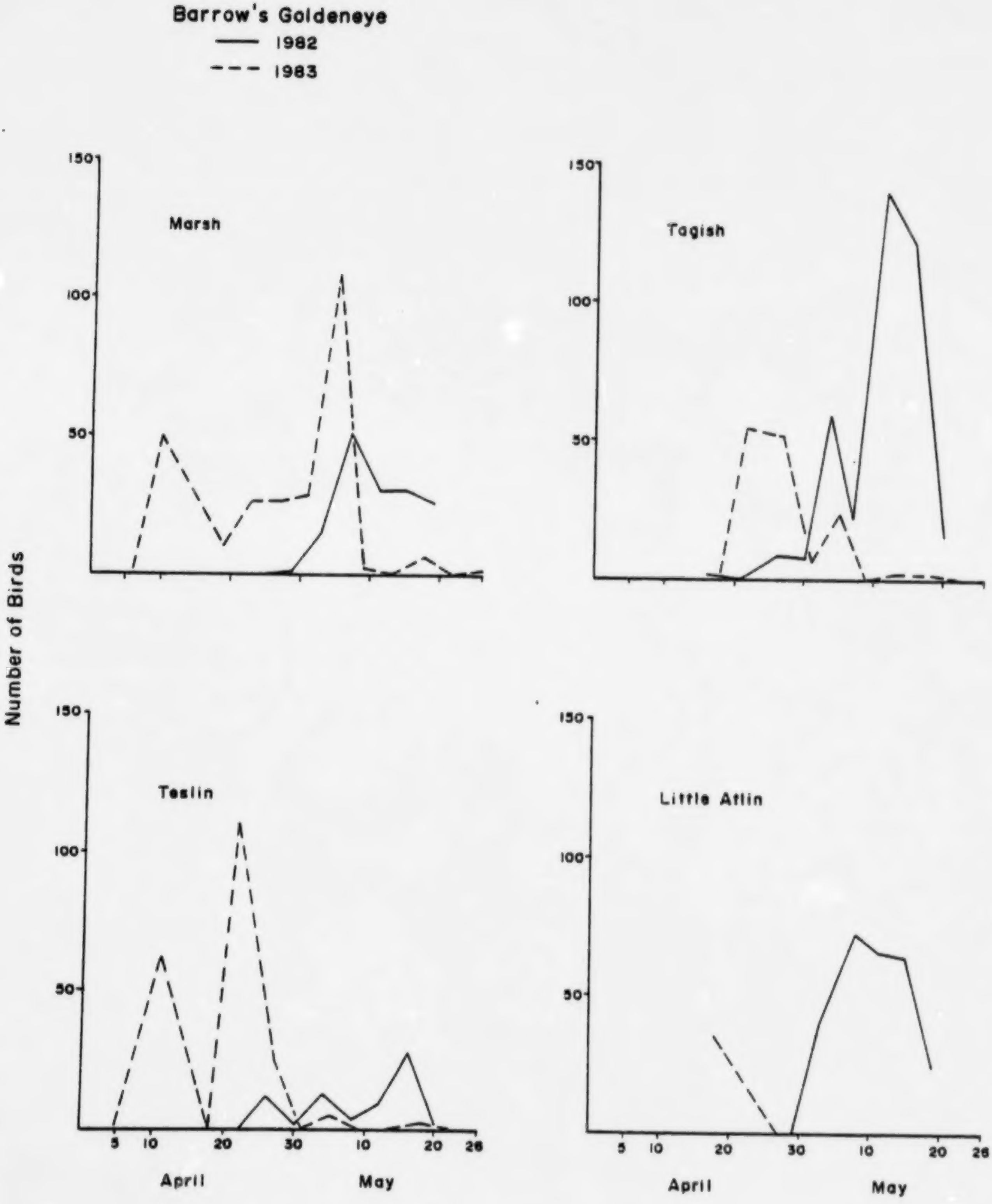


Figure 36 Number of Barrow's Goldeneye Counted During Census Periods in 1982 and 1983.

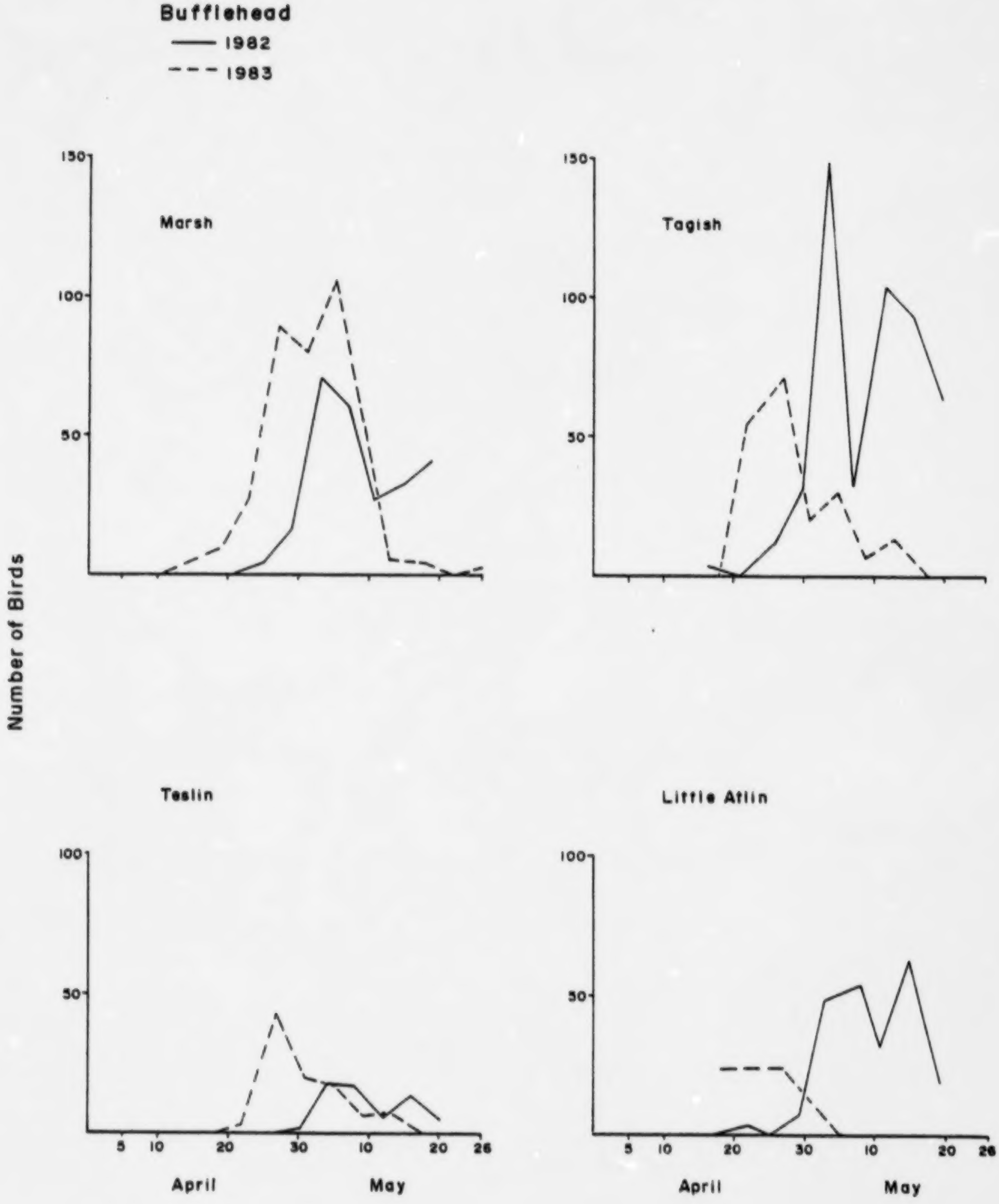


Figure 37 Number of Bufflehead Counted During Census Periods in 1982 and 1983.

numbers at the Teslin and Tagish sites. Bufflehead migration was still taking place on 20 May 1982 at all sites, but by 18 May 1983 had terminated at the Tagish, Teslin and Little Atlin sites.

The 1982 Bufflehead pattern of abundance at the staging sites was similar to observed patterns in 1978 and 1980 with respect to arrival dates, initial numbers and the timing and size of peak migration at the Marsh site (Milligan 1978; CWS unpubl. data).

Hooded Merganser

This species was rare in the study area. Hooded Mergansers were noted only during 1982 when one pair was counted on 4 May at the Tagish site. The species is not known to breed in the Yukon Territory and sightings are uncommon. Tagish residents have recorded this species during spring migration (Renewable Resources 1975).

Common Merganser

Common Mergansers were observed during the first surveys in 1982 and 1983, 16 April and 5 April respectively, at the Tagish site only. Tagish Lake retains an ice-free area through some winters and mergansers have been known to over-winter on this lake (Mossop 1976). The earliest observations of this species at the Tagish site may have involved birds that had over-wintered. In another study, two Common Mergansers were observed at Tagish Beach (Tagish Lake) on 8 April 1980 and two on 19 April 1980 (CWS, unpubl. data).

In 1982, the main migration was in the period 16 April to 19 May, with the highest numbers occurring from 29 April to 11 May (Figure 38). There was a maximum of 86 birds on 11 May at the Tagish site. The highest numbers in 1983 were in the period 27 April to 26 May, with a maximum of 26 birds on 9 May at the Tagish site, and a relatively late high count of 20 birds on 26 May at the Marsh site. Except for this

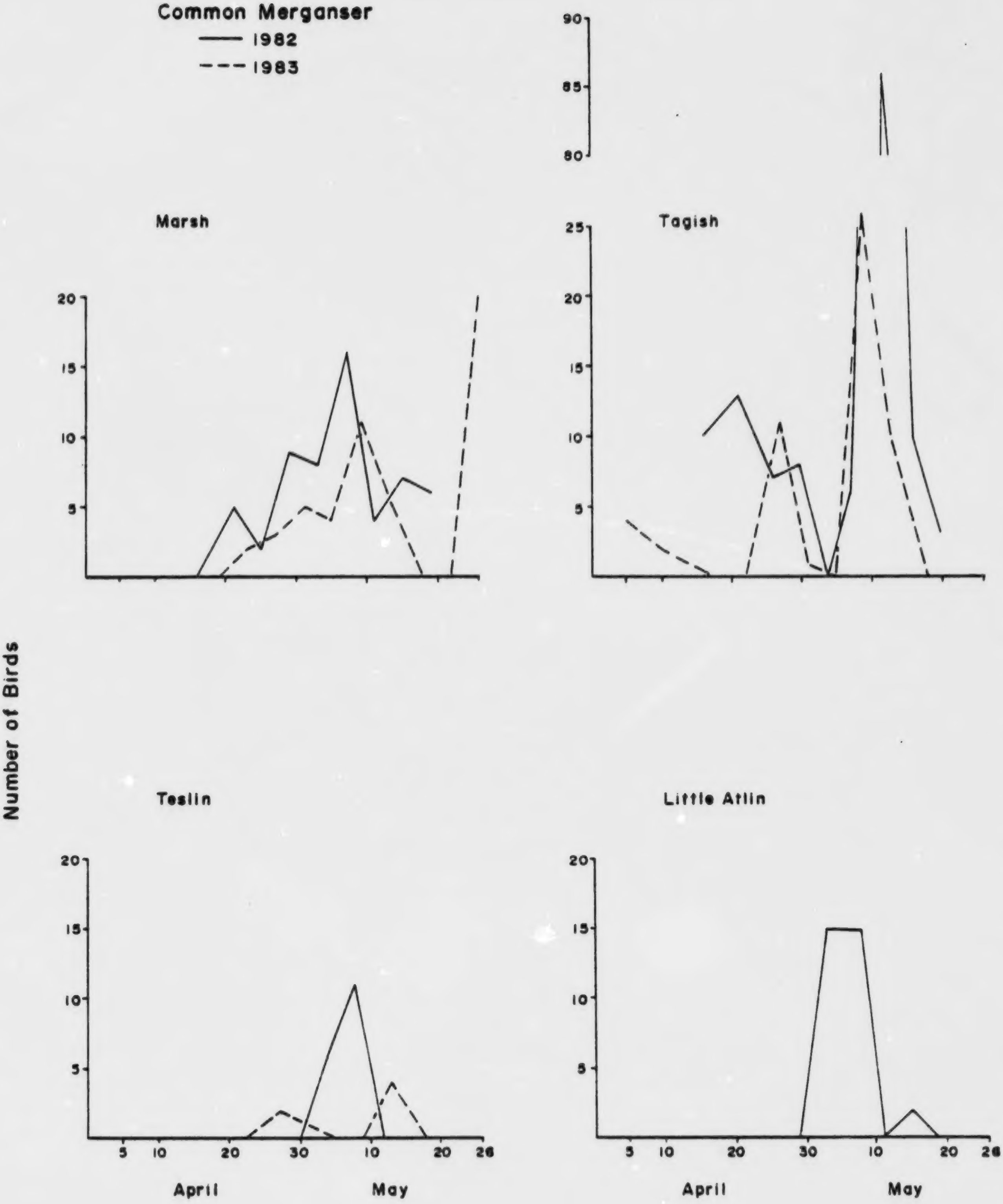


Figure 38 Number of Common Mergansers Counted During Census Periods in 1982 and 1983.

late count at Marsh Lake, the general trend for both years was an increase in numbers from mid or late April to about 10 May, followed by a decline in numbers over the next ten days.

Red-breasted Merganser

Red-breasted Merganser migration at the four study sites was slightly later than that of Common Merganser. The earliest dates of observation of this species were 25 April 1982 and 27 April 1983. Most birds were observed in the period 7 to 20 May 1982 and 5 to 18 May 1983 (Figure 39). A maximum of 66 birds was observed on 12 May at the Tagish site in 1982. In 1983, there was a high count of 18 on 13 May (Tagish site), with a higher count of 28 birds later in the season on 26 May (Marsh site). In another study, 6 Red-breasted Mergansers on 18 April 1978 and 25 on 23 April 1978 were observed at Marsh Lake's M'Clintock Bay (Milligan 1978).

American Coot

This species was rare in the study area. American Coots were observed only during 1982, with sightings at the Teslin, Marsh and Little Atlin sites. Never greater than two birds, this species occurred at the Teslin and Marsh sites on 7 and 8 May respectively, and at the Little Atlin site on 7 May and again on 19 May.

Shorebirds

Temporal and Spatial Distribution of Shorebirds, 1983

Shorebirds were first noted at the 3 major sites on 26 April. Shorebird numbers remained low at all sites until 9 May, thereafter,

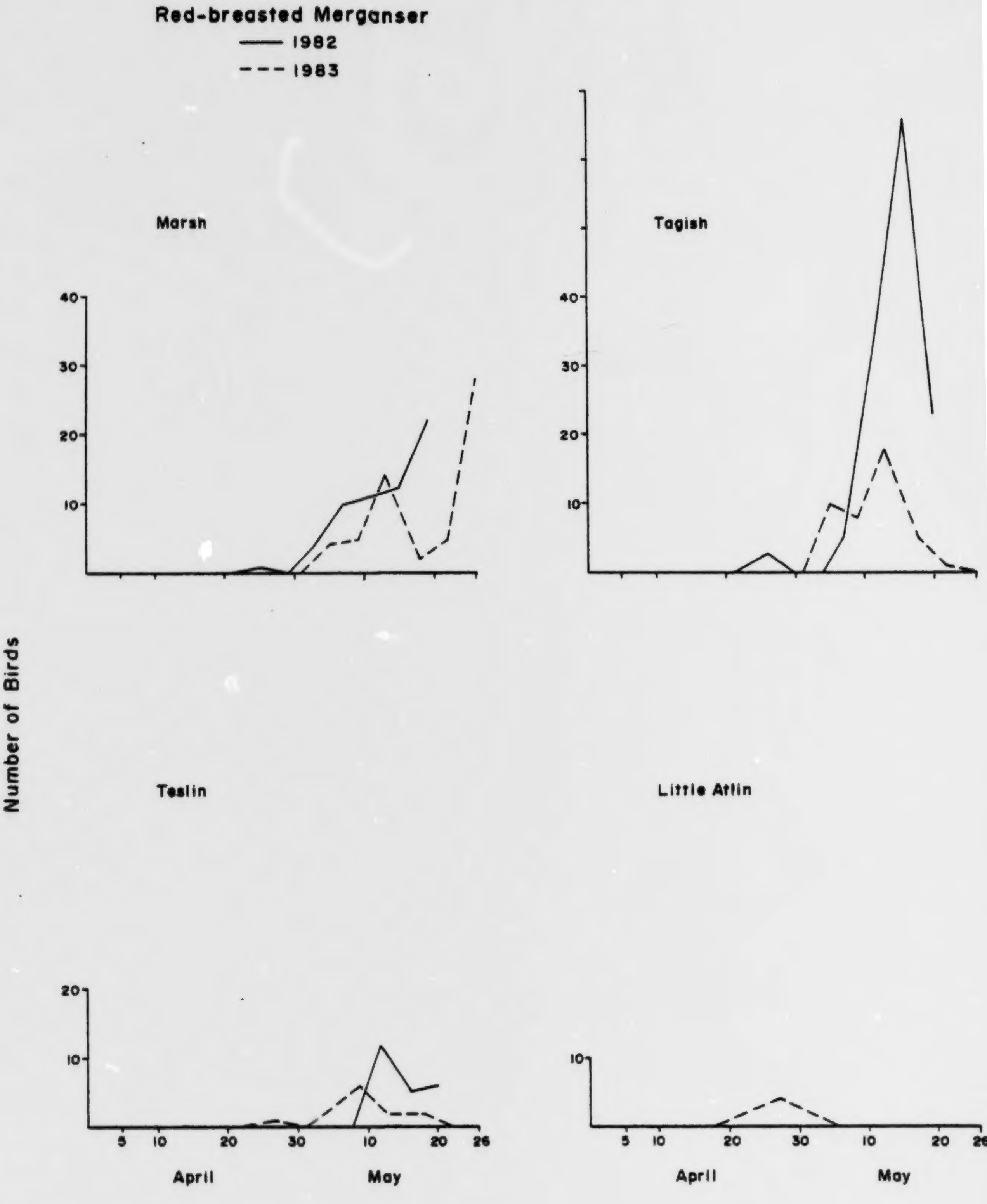


Figure 39 Number of Red-breasted Mergansers Counted During Census Periods in 1982 and 1983.

numbers began increasing rapidly (Figure 40). Peak numbers of shorebirds occurred at the Marsh site (841) and the Tagish site (630) on 18 May. Shorebird numbers also peaked at Teslin on 18 May, however only 92 shorebirds were observed. During peak migration 79, 54 and 50% of the shorebirds at Marsh, Teslin and Tagish respectively, were Pectoral Sandpipers.

Shorebird numbers declined rapidly after peaks on 18 May; by 22 May numbers of shorebirds had decreased by 40, 40 and 53% at Marsh, Teslin and Tagish respectively. By the last survey on 26 May, 157 shorebirds were present at Marsh and 28 at Tagish. Although shorebirds were present at staging sites on 26 April, the most use of the sites occurred between 9 May to 26 May.

Diversity, expressed as the total number of shorebird species was highest at Marsh Lake (13) and lowest at Teslin (7) (Table 36). Diversity remained low at all sites until 9 May at Marsh (3 species) and Tagish (5 species) and 18 May at Teslin (6 species). Maximum diversity at Marsh occurred on 13 May (11 species) and 18 May at Tagish (10 species) and Teslin (6 species). Over all sites, a total of 14 species of shorebirds were noted.

Pectoral Sandpipers were the most abundant species at all sites, ranging from 68% at Marsh to 43% at Tagish outlet (Table 37). The second most abundant species at Marsh (13%) and Tagish (8%) was dowitcher. Semi-palmated Sandpipers were the second most abundant species at Teslin (11%). Other common species were Least Sandpiper (7%) and Lesser Yellowlegs (6%).

Within Site Distribution of Shorebirds

Marsh Site

Shorebirds were most abundant in zone 7 (51%) and in zone 3 (42%) which corresponds to the zones with the greatest amount of exposed

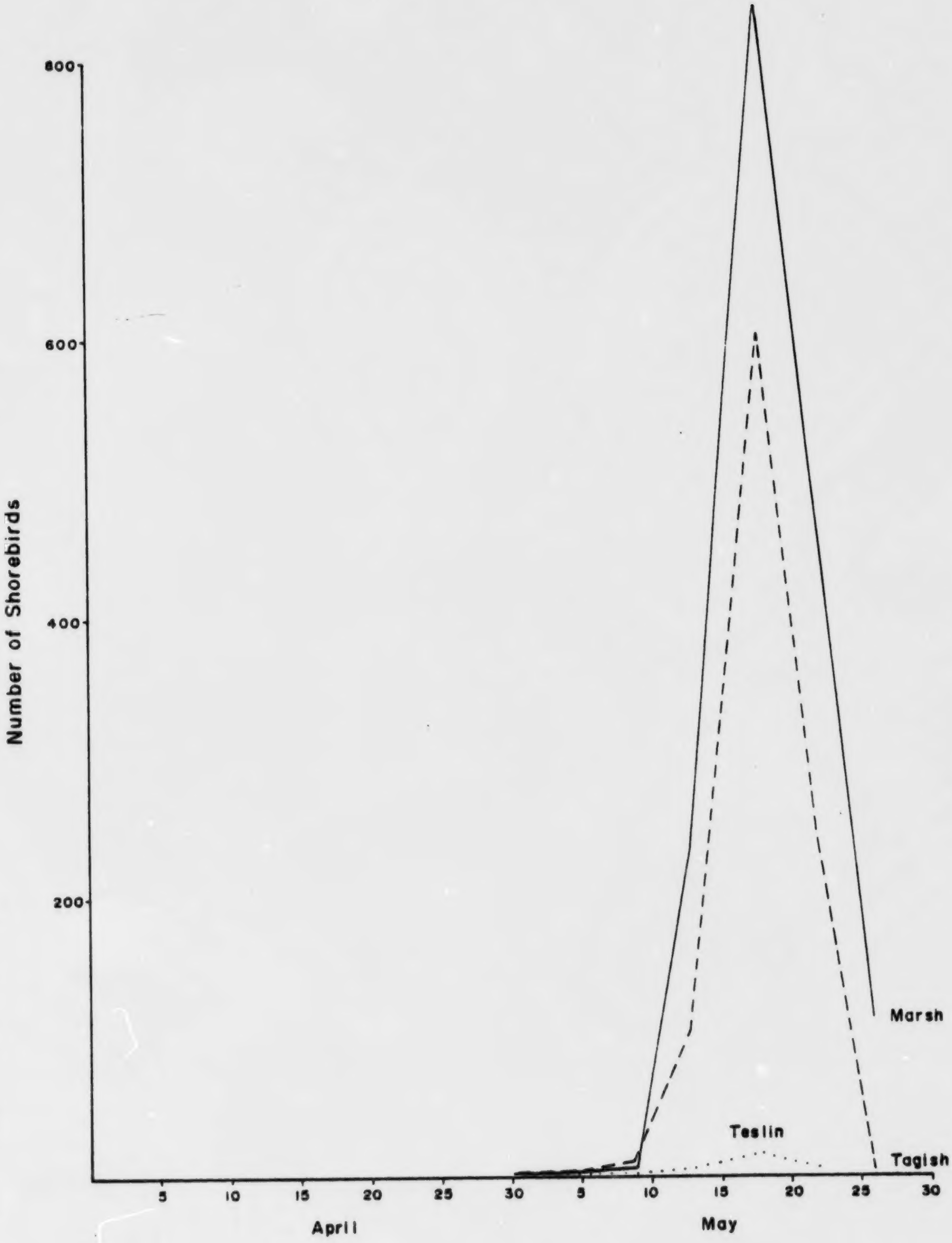


Figure 40 Temporal Abundance and Distribution of Shorebirds at the Staging Sites, Spring 1983.

TABLE 36 Number of Species of Shorebirds Observed During Each Census at Intensive Study Areas. Spring 1983.

	COUNT DATE								
LOCATION	27/4	1/5	5/5	9/5	13/5	18/5	22/5	26/5	TOTAL
Marsh Site	1	1	2	3	11	7	10	10	13
Tagish Site	2	1	1	5	9	10	8	4	11
Teslin Site	3	0	1	1	2	6	6	-	7

TABLE 37 Total Number of Shorebirds by Species Observed During all Censuses at Intensive Study Areas, Spring 1983.

	MARSH		TAGISH		TESLIN		TOTAL	
	Total	%	Total	%	Total	%	Total	%
Lesser Golden-Plover	8	0.4	2	0.2			10	<1
Semi-palmated Plover	19	1.0	42	3.0			61	2
Killdeer	3	0.2	3	0.4	4	2.2	10	<1
Lesser Yellowlegs	134	7.1	35	3.2	15	8.3	184	6
Solitary Sandpiper	2	0.1					2	< 1
Whimbrel	2	0.1					2	<1
Hudsonian Godwit	2	0.1	4	0.4			6	<1
Sanderling	3	0.2					3	<1
Semi-palmated Sandpiper	40	2.1	178	16.4	19	10.6	237	7
Least Sandpiper	14	0.7	122	11.3	8	4.4	144	6
Baird's Sandpiper	19	1.0	7	0.7	2	1.1	28	1
Pectoral Sandpiper	1,282	67.8	464	42.9	93	51.7	1,839	58
Peep (unidentified)	102	5.4	138	12.8	36	20.0	276	9
Dowitcher	241	12.7	82	7.6	3	1.7	326	10
Common Snipe	20	1.1	4	0.4			24	1
Total	1,891	100	1,081	100	180	100	3,152	100

mudflat (Table 38). None or < 1% of the total shorebirds were noted in zones 1, 2, 4 or 6. However, coverage of shorebird habitat at zones 6 and 4 was limited. The greatest species diversity occurred in zone 3 (8 species) and zone 7 (8 species). Shorebirds at the Marsh site represented 60% of the total shorebirds observed at the three major sites.

Tagish Site

Most of the shorebirds occurred in zone 1 (97%) (Table 39). Zone 1 corresponded to the area with the greatest amount of mudflat. Species diversity was high in zone 1 (11 species), and relatively high in zone 2 (7 species), however only 2% of the total shorebirds occurred in zone 2. No shorebirds were noted in zone 3, although this zone could only be covered using spotting scopes and undoubtedly a few shorebirds were overlooked. Among all sites, 34% of the shorebirds were noted at Tagish.

Teslin Site

Shorebirds occurred in all zones, however 90% of the total were observed in zone 4 (Table 40). Less than 5% were noted in the other three sites. Only Lesser Yellowlegs were recorded in all four zones. Species diversity was highest in zone 4 (7 species) and zone 3 (3 species). Only 180 shorebirds (6% of total) were observed at the Teslin site which, in view of the extensive mudflats available in zone 4 and zone 1, is surprising.

Shorebird Species Accounts

Lesser Golden-Plover

Lesser Golden-Plovers were observed at the Marsh site (8 birds) and at the Tagish site (2 birds); none were observed at the Teslin

TABLE 38 Percent Occurrence of Shorebirds by Zone at Marsh Lake Site, Spring 1983. Total observations summed over all count periods (n).

	ZONE					
SPECIES	2	3	5	6	7	(n)
Lesser Golden-Plover		25			75	8
Semi-palmated Plover		37	5		58	19
Killdeer		67			33	3
Lesser Yellowlegs		34		<1	59	134
Solitary Sandpiper		50			50	2
Whimbrel						2
Hudsonian Godwit						2
Sanderling						3
Semi-palmated Sandpiper						40
Least Sandpiper						14
Baird's Sandpiper			100			19
Pectoral Sandpiper		48	7		44	1.282
Peeps (unidentified)	<1	50			50	102
Dowitcher spp.		27			73	241
Common Snipe		45	15		40	20
Total	<1	42	7	<1	51	1.891

TABLE 39 Percent Occurrence of Shorebirds by Zone at Tagish Lake Site, Spring 1983. Total observations summed over all count periods (n).

	ZONE			
SPECIES	1	2	4	(n)
Lesser Golden-Plover	100			2
Semi-palmated Plover	98	2		42
Killdeer	100			3
Lesser Yellowlegs	94	6		35
Hudsonian Godwit	75		25	4
Semi-palmated Sandpiper	97	3		178
Least Sandpiper	98	2		122
Baird's Sandpiper	100			7
Pectoral Sandpiper	99	1		464
Peeps (unidentified)	92		8	138
Dowitcher	91	9		82
Common Snipe	75	25		4
Total	97	2	1	1.081

TABLE 40 Percent Occurrence of Shorebirds by Zone at Teslin Lake Site, Spring 1983. Total observations summed over all count periods (n).

	ZONE				
SPECIES	1	2	3	4	(n)
Killdeer	25		50	25	4
Lesser Yellowlegs	20	47	13	20	15
Semi-palmated Sandpiper				100	19
Least Sandpiper				100	8
Baird's Sandpiper			50	50	2
Pectoral Sandpiper				100	93
Peeps (unidentified)			6	94	36
Dowitcher				100	3
Total	2	4	4	90	180

site. The dates of sightings were all in mid-May: at Marsh Lake, there were 23 birds on 13 May, 2 on 18 May and 4 on 22 May; and at Tagish Lake, there were 2 on 18 May.

Semi-palmated Plover

Semi-palmated Plovers were observed at Marsh Lake (19 birds) and at Tagish Lake (42 birds); none were observed on Teslin Lake. Dates of sightings ranged from 9 May to 26 May, with the highest counts of 22 birds at Tagish Lake and 7 birds at Marsh Lake, on 26 May.

Killdeer

Killdeers were observed in small numbers at all three sites. In total, 10 birds were observed: 3 at Marsh Lake, 3 at Tagish Lake and 4 at Teslin Lake. Dates of observations ranged from 27 April to 26 May.

Lesser Yellowlegs

Lesser Yellowlegs were observed at all three sites, with the largest numbers on Marsh Lake (134 birds) and smaller numbers at Tagish and Teslin Lakes, 35 and 15 birds, respectively. Lesser Yellowlegs made up 7.1% of the total shorebirds at Marsh Lake, 3.2% at Tagish Lake and 8.5% at Teslin Lake. Dates on which the species was observed ranged from 27 April to 26 May. Peak numbers were observed on 9 May, with 60 birds observed at Marsh Lake, and 15 birds at Tagish Lake.

Solitary Sandpiper

Only two observations of Solitary Sandpiper were made, both at Marsh Lake. One bird was observed on 13 May and one on 26 May.

Whimbrel

Two individuals of this uncommon species were observed at Marsh Lake on 13 May. No other sightings were made.

Hudsonian Godwit

Hudsonian Godwits were observed at the Marsh and Tagish sites. Three individuals of this uncommon species were observed at the Tagish site on 13 May and one on 18 May. At the Marsh site, 2 birds were observed on 26 May.

Sanderling

The three Sanderlings observed at Marsh Lake on 10 May were the only individuals of this species observed in the study.

Semi-palmated Sandpiper

Semi-palmated Sandpipers were observed at all three sites, and overall, were the third most numerous shorebird species observed (after Pectoral Sandpiper and dowitcher spp.). The Tagish site had the highest numbers, with a total of 178 birds, making up 16.4% of shorebirds seen at this site. Forty birds (2.1% of shorebirds seen) were observed at the Marsh site, and 19 birds (10.6% of shorebirds) were observed at the Teslin site. Dates of sightings ranged from 13 May to 26 May, with a pronounced peak on 18 May: 168 birds (71% of the total 237 observed) were observed on this date.

Least Sandpiper

Least Sandpiper was observed at all three sites, with the preponderance of birds observed at the Tagish site. Total numbers and the percent of total shorebirds observed were: 122 (11.3%) at

Tagish Lake, 14 (0.7%) at Marsh Lake and 8 (4.4%) at Teslin Lake. Dates of observations ranged from 13 May to 26 May, with a peak count of 80 birds (56% of the total number observed) at Tagish Lake on 18 May. The proportion of birds counted on the 13, 18, 22 and 26 May, was: 27%, 58%, 14% and 1% respectively.

Baird's Sandpiper

Baird's Sandpipers were observed at all three sites, comprising 0.7% to 1.1% of the total shorebirds seen at each site.

In total, 19 were observed at Marsh Lake, 7 at Tagish Lake and 2 at Teslin Lake. There was an early sighting of one bird on 27 April (Teslin Lake), and remaining sightings ranged from 9 May to 22 May. The highest count, of 14 birds, was made at Marsh Lake on 13 May.

Pectoral Sandpiper

Pectoral Sandpipers were by far the most numerous species observed, comprising 42.9% to 67.8% of shorebirds observed at each site, and 58.8% of shorebird numbers overall. A total of 1,282 birds, was observed at the Marsh site; 464 birds were observed at the Tagish site; and 93 birds were observed at the Teslin site. Dates of observations ranged from 13 May to 26 May. Peak counts were made on 18 May, with 662 birds at Marsh Lake, 314 birds at Tagish Lake and 50 birds at Teslin Lake.

Dowitcher spp.

Dowitchers observed on surveys were not identified to species, but presumably consisted of both Long-billed and Short-billed Dowitchers (mostly the latter). Dowitchers were observed at all three sites, with a preponderance of birds at Marsh Lake: 241, compared with 82 birds at Tagish Lake and 3 birds at Teslin Lake. As a proportion of shorebirds observed at each site, dowitchers made up 12.7% of shorebirds at Marsh Lake, 7.6% at Tagish Lake, and 1.7% at Teslin Lake.

Dates of observations ranged from 9 May to 26 May, with peak numbers on 18 May. Counts on 18 May were of 103 birds at Marsh Lake, 60 birds at Tagish Lake and 3 birds at Teslin Lake, for a total of 166 birds, or 50.9% of birds observed over the total survey period. Counts on 13 and 22 May tallied 148 birds (45.4% of the total observed), and counts on 9 and 26 May tallied 12 birds (3.7% of the total).

Common Snipe

Common Snipe were observed at Marsh Lake (20 birds) and Tagish Lake (4 birds); none were observed at Teslin Lake. Dates of observations ranged from 27 April to 26 May, with 22 of the total 24 birds observed in the period 9 May to 22 May. The highest count was of 8 birds at the Marsh site on 9 May.

DISCUSSION

Chronology of Waterbird Abundance

The timing of waterbird use of the Marsh, Tagish, Teslin and Little Atlin spring staging sites was strikingly different between the two study years and was a function of spring phenology. During 1982, spring breakup was unusually late and during 1983, spring breakup was early. These differences in spring weather conditions between the two years were reflected in differences in the timing of: waterbird arrival at the sites, peak waterbird migration, and the end of waterbird migration. Generally, spring waterbird migration was 19 days later in 1982 than in 1983.

Waterbirds used the spring staging sites from 12 April to at least 20 May in 1982 and from 28 March to 26 May in 1983. Other studies at the staging sites have documented waterbird abundance within this range of dates (Foothills Pipelines (Yukon) Ltd. 1977, 1978; Milligan 1978; Anweiler and Blood 1981). Therefore, when considering the maximum time period which these sites could potentially be used by spring migrant waterbirds, the period should extend for eight weeks, from late March to late May.

At the waterbird species group level, swans and geese, the earliest groups to arrive and reach peak abundance at the sites, showed the least difference in timing of peak abundance between the two study years. Milligan (1978) estimated peak swan abundance at the Tagish and Marsh sites just slightly later (27-28 April) than the timing during the two years of this study. Both swans and geese must maximize on the limited amount of time available in the northern spring and summer seasons to incubate their eggs and raise their young, in time for fall migration and prior to freeze-up. Dabbling and diving duck peak abundance occurred after swan and geese peak abundance. Dabbling ducks peaked in abundance earlier than diving ducks. Milligan (1978) noted peak duck abundance on 27-29 April 1978 followed by a second increase in duck abundance up until, if not beyond, 5 May when the study terminated. This second increase may have been due to diving ducks reaching peak abundance. Loons and grebes were late arrivals to the sites, and the time of peak abundance was 11 days later in 1982 than in 1983.

Comparative Evaluation of the Sites

Waterbird Diversity and Abundance

The number of waterbird species (35), recorded during this two year study was greater than the 24 species recorded by Milligan (1978) and lower than the 36 species listed by Renewable Resources Consulting Services Ltd. (1975). The differences in the number of species recorded by the different studies, and in this study between sites and years, were due to the presence or absence of a few rare or less abundant species. During this study, the abundant species occurred at all sites. In 1982, the Tagish site had the highest species diversity (27 waterbird species) and in 1983, the Marsh site had the highest diversity (26 species). However, differences among the four sites were never more than four species.

From the results of the paired T-tests and the number of waterbird-use days, the Little Atlin site is of minor importance when ranked against the three major sites. Without considering the quality of available habitat at the Little Atlin site, the mere small area of early open water at this site in early spring limits the possible abundance of waterbirds. The Little Atlin site is more representative of the many small early open water areas located during the aerial reconnaissance of Northern British Columbia, than it is of early open water at the major lake outlets.

In terms of waterbird-use days, as a comparative measure of the total numbers of waterbirds using each site over time, Teslin was not as important as Tagish or Marsh. The relative importance of the Marsh and Tagish sites to waterbirds varied between years and was likely dependent on habitat availability and quality. During an early spring, the mudflats and shallow waters of the M'Clintock River delta at the Marsh site became available sooner than during a year of late break-up (1982). Once available, this delta area was a concentration area of swans and ducks. The greatest waterbird abundance among the three major sites has varied from year to year between Marsh and Tagish (Foothills Pipelines (Yukon) Ltd. 1977, 1978; Anweiler and Blood 1981). In a compilation of important migratory bird habitat in the Yukon, Dennington (1981) recognized Marsh and Tagish Lake outlets as "critical" waterfowl habitat.

The predominant abundance (80% of the total waterbirds) of dabbling ducks at the staging sites is similar to findings of other reports (Foothills Pipelines (Yukon) Ltd. 1977, 1978; Milligan 1978; Anweiler and Blood 1981). The most common dabbling duck species in 1982 were (in order of abundance); Green-winged Teal, American Wigeon, Mallard and Northern Pintail, and in 1983 were: Northern Pintail, American Wigeon, Mallard and Green-winged Teal. Scaup spp., goldeneye spp. and Canvasback were the more abundant diving ducks.

The abundance of swans, in terms of swan-use days, was markedly different between the two years (10,985 in 1982 vs 36,032 in 1983). During both years, swans used the Marsh site the most and used the Teslin site more than the Tagish site. The prominent use of the Marsh site by swans is similar to findings from other studies (Foothills Pipelines (Yukon) Ltd. 1977; Anweiler and Blood 1981).

Fewer swans and geese used the three major staging sites during the year of a late spring (1982) than during an early spring (1983). However, we suspected that the staging sites would be most important to swans during a late spring, as swans would have to rely on the early open water sites for feeding and loafing and so would concentrate at the sites until thaw conditions were favourable in more northern areas. Evidently this was not the case. Swans require a long time period for incubation and brood-rearing (Bellrose 1976) relative to the short northern summer. There may be a physiological advantage for geese and swans to promptly arrive at the breeding grounds, thus allowing the earliest possible initiation of egg-laying, once spring conditions become favourable. Dirschl (1970) suggested that factors other than the availability of habitat types may influence spring migrant waterfowl abundance at the Peace-Athabasca delta, namely: the magnitude of the waterfowl population and spring phenology. During a late spring he expected many birds to overpass the delta.

Waterbird Abundance at Other Open Water Sites

River outlets were the most common type of early open water sites and supported the greatest abundance of waterbirds. This may be a function of deltaic formations at these sites. Nutrient and silt deposition by the river at outlets may enhance productivity and increase the amount of shallow water available as feeding areas. Specific areas of high waterbird abundance were sites drained by Teslin Lake and included the Swift, upper Teslin and Hayes Rivers. Waterbird abundance was especially high at Hutsigola Lake on the Teslin River. Hutsigola Lake is where the Teslin River forms a delta of extensive shallow waters, bars and vegetated islands (McEwen and Johnston 1983). Submergent aquatic plant growth is prolific at Hutsigola Lake.

Similar to the major staging sites (Marsh, Tagish and Teslin), ducks were the most abundant (>90%) waterfowl. However, swans were relatively less abundant (2% of the total waterfowl) than at the major sites. The low swan abundance could be a function of various influences: traditional use of major sites, the small area of open water, the size of the bird and flock size relative to the area of open water, and other psychological effects. Canada Geese, in 1983, were relatively more abundant at the minor sites than at the major sites. Approximately 37% of the total goose observations during the aerial survey occurred at Hutsigola Lake on the Teslin River. Geese noted during the spring reconnaissance flights may represent staging areas for local populations. McEwen and Johnston (1983) noted an abundance of Canada geese at Hutsigola Lake and adjacent areas throughout the summer. Foothills Pipelines (Yukon) Ltd. (1977, 1978) noted that spring migrant Canada geese were very abundant at Nisutlin River delta, which may represent a staging area for another local population.

Regional Importance

Although thousands of waterbirds stop at spring staging sites within the Yukon River Basin during spring migration, the sites are not of major importance on a continental scale (except for Trumpeter Swans). No individual open water sites in the Yukon River drainage compare to the Peace-Athabasca delta, nor Hay-Zama Lakes (Dirschl 1970; Bellrose 1976) in terms of waterfowl abundance. However, similar numbers of spring migrants use the three major sites, as occur at the Slave River delta (Thompson et al 1981). During peak migration in 1983 an estimated 42,000 waterbirds were using early open water sites, including both major and minor sites, in the southern Yukon River Basin (Appendix 12).

The staging sites are of regional importance to local populations of Canada Geese which nest in the Yukon River Basin (Johnston and McEwen 1983; McEwen and Johnston 1983) and to the continental population of Trumpeter Swans. Canada Geese may use early open water sites, particularly those sites in the Teslin Lake drainage system, as feeding and loafing areas while awaiting local breeding areas to become snowfree. A large portion of the estimated 7,696 Trumpeter Swans nesting in Alaska (King and Conant 1980) utilize Marsh, Tagish and Teslin Lake outlets during spring migration. On the 18 April 1983 count, 804 Trumpeter Swans, or 10% of the Alaska population were recorded at the lake outlets. The majority of these swans were in M'Clintock Bay of Marsh Lake.

Waterbird Habitat Use and Behaviour

At the minor sites, the area of open water was a good predictor of the number of waterfowl using the site. However, at the major sites, the distribution of birds among the zones was not well explained by only consideration of the area of open water. The area of exposed mudflat and shallow water (<1m deep) explained much of the variation in bird abundance between zones. Zones within the three major sites that received the greatest amount of waterbird use were: zone 3 (Yukon River) and zone 7 (Marsh Lake outlet) at the Marsh site, zone 1 (Marsh Lake inlet) and zone 2 (Tagish River) at the Tagish site, and zone 2 (Teslin River) and zone 4 (Teslin Lake outlet) at the Teslin site. These zones that had relatively high waterbird use were all characterized by having large expanses of mudflats and/or shallow water. The scarcity of waterbirds along the Yukon River (zones 1, 2, 4, 5, 6) at the Marsh site was a function of the lack of extensive shallow areas or mudflats, for feeding and loafing. Similarly, much of the Tagish River which received little waterbird use had no shallow areas or exposed mudflat. The Teslin River, zones 1-3 at the Teslin site, received proportionately more bird use than zones of the Yukon River. Within each zone of the Teslin River there were wide shelves of shallow water as well as extensive mudflats.

Although waterbird distribution and abundance was explained by the area of mudflats and shallow water available, habitat quality, in terms of the presence or absence of waterbird food sources (aquatic vegetation and invertebrates) was also important. A prime example of this is Tagish Lake outlet (zone 4) where extensive areas of exposed mudflats and shallow water occurred, yet little use was made of this area by waterbirds. Vegetation sampling in the area suggested total detritus and live plant biomass was very low at this zone.

Waterbirds used the major sites predominantly for feeding. Feeding areas included exposed mudflats, near shore areas and off shore areas. On average, among the sites sampled, near shore areas and mudflats had the greatest amounts of plant biomass. Available plant foods to waterbirds during spring migration included tubers, root systems and new growth shoots of pondweed (Potamogeton spp.), mare's tail (Hippuris vulgaris), and water milfoil (Myriophyllum spp.). Mare's tail was noted only at the Marsh site and its abundance may be responsible for the high abundance of waterbirds in general and specifically swans, at Marsh Lake outlet. "Shoots" were noted at all sites and likely represented pondweed, which was abundant and grew extensively at the sites during the summer sampling. The use of tubers and root systems of pondweed by waterfowl is well documented (Bergman 1973; Anderson and Low 1976; Sugden and Driver 1980; Hughes and Young Jr. 1982).

Dennis and Chandler (1974) noted migrant waterfowl in the Great Lakes area made heavy use of bay areas vegetated with Potamogeton pectinatus. Anderson and Low (1976) sampled sediment for aquatic plant growth, to a depth of 30 cm and found that only Tundra Swans and Canvasbacks could access tubers beyond depths of 15 cm of sediment. We sampled the sediment to an approximate depth of 10 cm.

The plant biomass estimates represent a minimum estimate because sampling was conducted after waterfowl had fed in the areas. Anderson and Low (1976) estimated that over a one year period, waterfowl had consumed and destroyed 26.3 g/m^2 of Potamogeton pectinatus tubers, or 42.9% of the available tuber biomass.

The available habitat at the Little Atlin site to spring migrant waterbirds was unlike habitat at the three major sites and may have been an influencing factor in waterbird abundance at the site. No exposed mudflats were available at this site. Emergent stands of horsetails (Equisetum spp.) and sedges (Carex spp.) were present at the Little Atlin site while absent at the other intensively sampled sites. Geese represented 9.5% of the waterbirds at this site, exceeding their proportional abundance at the Marsh, Tagish or Teslin sites. The abundance of geese was probably a function of the presence and abundance of horsetails, a good source of protein and nutrients to migrant geese (Thomas and Prevett 1982).

Exposed mudflats were used for feeding principally by dabbling ducks, presumably for both plant and invertebrate food sources. Apart from the plant sampling, cursory examination of mudflats where dabbling ducks fed revealed heavy mats of dead aquatic vegetation and large numbers of invertebrates, principally Corividae (water boatmen) and larvae of Chironomidae (midges). Both Corixidae and Chironomidae are frequently consumed by dabbling ducks during the spring, summer and fall (Dirschl 1970; Danell and Sjoberg 1980; Sugden and Driver 1980). Anweiler and Blood (1981) noted heavy use of mudflats by dabbling ducks during spring staging, at the Marsh and Teslin sites in 1980.

Water levels at the staging sites fluctuate annually, at least two metres, being lowest in late April or early May. These fluctuations affect waterbird use of the sites. The low water depths expose areas of the lake bottom (mudflats) and create shallow water areas (< 1 m deep) where waterfowl are able to feed on seeds, root systems, tubers and new shoots of aquatic vegetation. The Teslin site serves to illustrate the significance of water depth. Increases in water level occurred earliest at this site, submerging mudflats and deepening shallow areas, and consequently, waterbird use of the site (in 1983) was curtailed sooner than at the Marsh and Tagish sites.

Additionally, aquatic plant productivitiy may be enhanced by seasonal fluctuations in water levels. It is common practice to drawdown and later flood wetland areas, to change or increase aquatic vegetation species presence and/or productivity, and thus improve the area for waterfowl habitat (Kadlec 1962; Meeks 1969). Although the timing of drawdown and flood at the staging sites may not parallel the timing of manipulations of water regimes for marsh management, the cause and effect of the process to plant productivity are probably similar. At the staging sites, the productivity of the submergent vegetation of principally species of Potamogeton (pondweed), may depend and thrive on the cyclic changes of water levels and also the specific magnitude of change.

On the average, most waterbirds and particularly dabbling ducks were feeding at the staging sites. However, more feeding activity than suggested by this study's results likely occurred. The results are likely an underestimate since the data are only from daylight hours, and many species of waterfowl, particularly dabbling and diving ducks, feed at night (Pedroli 1982; Thornburg 1973). Casual observations of waterbirds at Marsh Lake outlet, with the aide of a nightscope, revealed that swans were active and were likely feeding in the Marsh Lake site during hours of darkness.

From the behaviour watches and census data, waterbirds spent considerable amounts of time feeding, while at the staging sites. Many species of northern breeding waterfowl, particularly geese, depend on fat deposits accumulated during or before spring migration for successful breeding (Wypkema and Ankney 1979; Fox and Madsen 1981; Krapu 1981; McLandress and Raveling 1981). Staging sites in the Yukon River Basin may offer the best areas for feeding to waterbirds, prior to continuing to more northerly breeding grounds or dispersing to local nesting areas. Unfortunately, we do not know how long individual birds remain at these sites nor if they maintain or increase fat reserves while at the sites.

Disturbance

Although this study did not address disturbance to staging waterbirds, on occasion disturbance was noted causing the birds to change their activity and area of use. Given that most of the waterbirds spent much time feeding while at the sites, the relatively high levels of disturbance noted by Milligan (1978) and Dennington (1976) and in this study (Appendix 13) at the Tagish, Marsh and Teslin sites may be cause for concern. The effects and levels of disturbance at these sites have not been quantified, however, other studies suggest that human disturbance to waterfowl at staging sites can have deleterious effects (LGL Limited 1974; Geist 1975). Disturbance to the waterbirds may mean that they leave Marsh, Tagish and Teslin staging sites in poorer condition than when they arrived. Although minor open water sites in the Yukon River Basin, particularly in northern British Columbia, support significantly fewer birds than the large lake outlets, the minor sites may be important as disturbance-free areas to migrant waterbirds. Birds using these sites may have a physiological advantage over birds using the more disturbed sites. These ideas remain conjecture until the dynamics of staging waterbirds in the southern Yukon Territory are better understood.

Shorebirds

Bradstreet *et al* (1977) defined two types of important shorebird habitat at Long Point, Ontario: the shore/water interface, and mudflat pools. The Marsh site which had the greatest number of shorebirds counted also had the greatest length of shore/water interface. Correspondingly, Tagish had the second largest abundance of shorebirds and the second greatest length of shore/water interface. However, in terms of area of mudflats available and shorebird abundance, no pattern was apparent. The Teslin site had the greatest mudflat area and the least number of shorebirds. Shorebird use of mudflats is in part a function of mudflat quality. We noted that shorebird distribution and abundance on mudflats was a function of the moistness of the mud and the occurrence of pools of water. As previously mentioned, the mudflat pools were prolific in water boatmen and midge larvae which are a shorebird food source. Bradstreet et al (1977) found that specific species of shorebirds: yellowlegs, dowitchers and Least Sandpiper, preferred mudflat pools rather than the shore/water interface. As the lake level at Long Point rose, the beach habitat deteriorated and the abundance of these species preferring pools, declined. The attraction of spring migrant shorebirds to mudflats or drawdown areas has also been noted by Rundle and Fredickson (1981) and Thompson et al (1981).

No other shorebird studies have been documented for the southern Yukon. At the Slave River delta, spring migrant shorebirds were scarce (Thompson et al 1981). Of the shorebirds noted, Baird's Sandpiper were most common at the delta.

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APPENDICES

APPENDIX 1 Census Dates at the Four Intensive Study Areas in 1982 and 1983.

MARSH		TAGISH		TESLIN		LITTLE ATLIN	
1982	1983	1982	1983	1982	1983	1982	1983
16 April	6 April	16 April	5 April	17 April	5 April	17 April	18 April
21 April	10 April	21 April	10 April	22 April	11 April	22 April	27 April
25 April	19 April	26 April	18 April	26 April	18 April	25 April	5 May
29 April	23 April	30 April	22 April	30 April	22 April	29 April	
3 May	27 April	4 May	27 April	4 May	27 April	3 May	
7 May	1 May	7 May	1 May	8 May	1 May	8 May	
11 May	5 May	12 May	5 May	12 May	5 May	11 May	
15 May	9 May	16 May	9 May	16 May	9 May	15 May	
19 May	13 May	20 May	13 May	20 May	13 May	19 May	
	18 May		18 May		18 May		
	22 May		22 May		22 May		
	26 May		26 May				

APPENDIX 2 Waterbird and Shorebird Species Observed at the Staging Sites, 1982 and 1983.

SPECIES	
Arctic Loon	*Gavia arctica*
Common Loon	*Gavia immer*
Horned Grebe	*Podiceps auritus*
Red-necked Grebe	*Podiceps grisegena*
Tundra Swan	*Cygnus columbianus*
Trumpeter Swan	*Cygnus buccinator*
Greater White-fronted Goose	*Anser albifrons*
Snow Goose	*Chen caerulescens*
Canada Goose	*Branta canadensis*
Green-winged Teal	*Anas crecca*
Mallard	*Anas platyrhynchos*
Northern Pintail	*Anas acuta*
Blue-winged Teal	*Anas discors*
Cinnamon Teal	*Anas cyanoptera*
Northern Shoveler	*Anas clypeata*
Eurasian Wigeon	*Anas penelope*
American Wigeon	*Anas americana*
Canvasback	*Aythya valisineria*
Redhead	*Aythya americana*
Ring-necked Duck	*Aythya collaris*
Greater Scaup	*Aythya marila*
Lesser Scaup	*Aythya affinis*
Oldsquaw	*Clangula hyemalis*
Surf Scoter	*Melanitta perspicillata*
White-winged Scoter	*Melanitta fusca*
Common Goldeneye	*Bucephala clangula*
Barrow's Goldeneye	*Bucephala islandica*
Bufflehead	*Bucephala albeola*
Common Merganser	*Mergus merganser*
Red-breasted Merganser	*Mergus serrator*
Lesser Golden-Plover	*Pluvialis dominica*
Semi-palmated Plover	*Charandrius semipalmatus*
Killdeer	*Charadrius vociferous*
Lesser Yellowlegs	*Tringa flavipes*
Solitary Sandpiper	*Tringa solitaria*
Whimbrel	*Numenius phaeopus*
Hudsonian Godwit	*Limosa haemastica*
Semi-palmated Sandpiper	*Calidris pusilla*
Least Sandpiper	*Calidris minutilla*
Baird's Sandpiper	*Calidris melanotos*
Short-billed Dowitcher	*Limnodromus scolopaceus*
Long-billed Dowitcher	*Limnodromus scolopaceus*
Common Suipe	*Gallinago gullinago*

APPENDIX 3 Number of Hours and Time Scan Samples were Conducted at each Site, Spring 1982.

SITE	DATE	TIME†	HOURS OBSERVED
Little Atlin	April 29	1515 - 1715	2.0
	May 3	1400 - 1700	3.0
	May 8	1600 - 1800	2.0
	May 11	1400 - 1700	3.0
Teslin	April 22	1245 - 1700	5.25
	April 26	1345 - 1545	2.0
	April 30	1230 - 1600	3.5
	May 12	1400 - 1615	2.25
	May 16	1330 - 1615	2.45
Marsh	April 28	0800 - 1730	9.5
	May 6	0630 - 0945	3.25
	May 6	1015 - 1315	3.0
	May 6	1445 - 1745	3.0
	May 14	0645 - 1045	4.0
Tagish	April 23	0630 - 1200	5.5
	April 23	1230 - 1530	3.0
	May 1	0630 - 1145	5.25
	May 1	1345 - 1445	1.0
	May 1	1515 - 1730	2.25
	May 9	0845 - 1145	3.0
	May 9	1300 - 1600	3.0
TOTAL			71.2

† Pacific Standard Time.

APPENDIX 4 Waterbird Species Presence and Abundance at Each Site, Spring 1982. Totals are in parentheses.

	% OF TOTAL BIRDS									
SPECIES	LITTLE ATLIN		MARSH		TESLIN		TAGISH		ALL SITES	
Arctic Loon			0.1	(8)	0.1	(10)			<0.1	(18)
Common Loon	0.2	(5)	<0.1	(5)	0.2	(14)	0.6	(69)	0.3	(93)
Horned Grebe	0.5	(12)	0.2	(27)	0.5	(33)	1.3	(152)	0.7	(224)
Red-necked Grebe	2.1	(47)	0.2	(26)	0.8	(60)	1.0	(119)	0.8	(252)
Swan spp.	3.0	(68)	15.5	(1707)	12.0	(872)	5.9	(693)	10.4	(3335)
Greater White-fronted Goose	0.6	(13)	0.1	(9)			0.1	(14)	0.1	(36)
Snow Goose	<0.1	(1)	<0.1	(4)	0.1	(7)			<0.1	(12)
Canada Goose	8.9	(200)	1.1	(117)	0.1	(9)	1.3	(152)	1.5	(478)
Green-winged Teal	4.5	(101)	20.7	(2279)	18.2	(1328)	19.5	(2279)	18.6	(5987)
American Black Duck							<0.1	(1)		(1)
Mallard	7.4	(165)	11.8	(1294)	18.0	(1310)	12.2	(1421)	13.0	(4190)
Northern Pintail	11.5	(257)	15.1	(1665)	13.5	(983)	11.1	(1296)	13.0	(4200)
Blue-winged Teal	0.3	(6)			0.2	(5)	<0.1	(3)	<0.1	(14)
Northern Shoveler	0.5	(11)	1.3	(140)	1.0	(76)	1.4	(160)	1.2	(387)
Eurasian Wigeon					<0.1	(1)	<0.1	(1)	<0.1	(2)
American Wigeon	12.3	(275)	12.2	(1338)	20.7	(1506)	15.9	(1859)	15.5	(4976)
Canvasback	6.1	(136)	6.1	(666)	2.3	(171)	8.9	(1037)	6.2	(2010)
Redhead	0.3	(7)	0.3	(36)	<0.1	(2)	0.4	(42)	0.3	(87)
Ring-necked Duck	1.8	(40)	0.1	(12)	0.3	(23)	0.2	(20)	0.3	(95)
Scaup spp.	10.8	(242)	5.5	(608)	3.9	(286)	8.0	(940)	6.4	(2076)
Harlequin Duck							0.1	(6)	<0.1	(6)
Surf Scoter	0.2	(5)	0.8	(92)	0.2	(11)	0.1	(12)	0.4	(120)

continued . . .

APPENDIX 4 continued . . .

	% OF TOTAL BIRDS									
SPECIES	LITTLE ATLIN		MARSH		TESLIN		TAGISH		ALL SITES	
White-winged Scoter	0.2	(4)	0.2	(26)	0.1	(6)	<0.1	(2)	0.1	(38)
Common Goldeneye	5.2	(116)	3.8	(413)	5.5	(400)	4.6	(542)	4.6	(1471)
Barrow's Goldeneye	12.0	(268)	1.5	(160)	0.9	(69)	2.6	(306)	2.5	(803)
Bufflehead	10.1	(227)	2.3	(251)	0.8	(60)	3.0	(346)	2.7	(884)
Hooded Merganser							<0.1	(2)	<0.1	(2)
Common Merganser	1.4	(32)	0.5	(57)	0.2	(17)	0.9	(100)	0.6	(206)
Red-breasted Merganser			0.5	(60)	0.3	(23)	1.0	(114)	0.6	(197)
American Coot	0.1	(2)	<0.1	(2)	<0.1	(2)			<0.1	(6)
Total Number	100.0	2240	100.0	10996	100.0	7284	100.0	11686	100.0	32206
Total Species		25		26		27		28		31

APPENDIX 5 Waterbird Species Presence and Abundance at Each Site, Spring 1983. Totals are in parentheses.

SPECIES	% OF TOTAL BIRDS									
	LITTLE ATLIN		MARSH		TESLIN		TAGISH		ALL SITES	
Common Loon			<0.1	(4)	0.4	(21)	0.5	(47)	0.3	(72)
Loon spp.			<0.1	(8)	0.4	(21)	0.5	(47)	0.3	(76)
Horned Grebe			0.4	(61)	0.6	(32)	1.0	(90)	0.6	(183)
Red-necked Grebe			<0.1	(4)	0.6	(35)			0.1	(39)
Swan spp.	42.9	(12)	34.0	(4789)	30.9	(1710)	16.4	(1420)	28.0	(7919)
Greater White-fronted Goose			<0.1	(2)	<0.1	(2)	<0.1	(1)	<0.1	(5)
Snow Goose							<0.1	(1)	<0.1	(1)
Canada Goose			2.6	(367)	0.3	(17)	0.8	(68)	1.6	(452)
Green-winged Teal			6.2	(876)	13.0	(721)	6.3	(544)	7.6	(2141)
Mallard			7.0	(990)	14.0	(775)	16.7	(1452)	11.4	(3217)
Northern Pintail			15.0	(2114)	9.6	(532)	18.1	(1575)	14.9	(4221)
Blue-winged Teal			<0.1	(10)			0.1	(11)	0.1	(21)
Cinnamon Teal			<0.1	(2)			<0.1	(4)	<0.1	(6)
Northern Shoveler	14.3	(4)	2.0	(285)	2.1	(117)	0.8	(70)	1.7	(472)
Eurasian Wigeon					<0.1	(2)			0.1	(2)
American Wigeon			12.5	(1754)	11.6	(639)	15.3	(1332)	13.2	(3725)
Canvasback			3.1	(430)	3.1	(174)	3.6	(312)	3.2	(916)
Redhead			0.2	(22)	0.1	(5)	<0.1	(6)	0.1	(33)
Ring-necked Duck	28.5	(8)	0.6	(82)	0.4	(24)	0.4	(37)	0.5	(143)
Scaup spp.			4.9	(694)	1.2	(64)	3.2	(282)	3.7	(1040)
Oldsquaw			0.2	(25)					0.1	(25)
Surf Scoter			0.8	(107)	0.1	(5)	1.8	(160)	1.0	(272)
White-winged Scoter			0.3	(40)			<0.1	(6)	0.2	(46)

continued . . .

APPENDIX 5 continued . . .

SPECIES	% OF TOTAL BIRDS									
	LITTLE ATLIN		MARSH		TESLIN		TAGISH		ALL SITES	
Scoter spp.			1.6	(220)	0.7	(40)	2.0	(172)	1.5	(432)
Common Goldeneye			1.2	(173)	3.1	(169)	4.7	(411)	2.7	(753)
Barrow's Goldeneye			1.8	(260)	3.7	(207)	1.6	(141)	2.1	(608)
Goldeneye spp.			1.6	(220)	0.7	(40)	2.0	(172)	1.5	(432)
Bufflehead			2.7	(380)	1.8	(99)	2.2	(196)	2.4	(675)
Common Merganser			0.4	(51)	0.1	(7)	0.6	(54)	0.4	(112)
Red-breased Merganser	14.3	(4)	0.4	(58)	0.3	(14)	0.4	(42)	0.4	(114)
Total Number		(28)		(14075)		(5528)		(8678)		(28281)
Total Species		5		26		23		25		28

APPENDIX 6 Site Description and Number of Waterfowl Observed on Each Water Area, Northern B.C., 8 May 1982. For Type, 1 = river outlets. 2 = river inlets. 3 = river channels, 4 = lake channel. Total+ includes dabbling, diving and unidentified ducks.

NUMBER	LOCATION	TYPE	SIZE	DUCKS			CANADA GEESE	SWANS	TOTAL
				Dabbling	Diving	Total+			
1	Jennings R.	1	150.0	100	300	400		40	440
2	Teslin L.	4	97.0	137	132	269	22		291
3	Teslin R.	1	9.0	3	63	66			66
4	Hayes R.	1	0.4						0
5	Small L. #1	4	<0.1	2	8	10			10
6	Small L. #2	4	<0.1		12	12	7		19
7	Hitchcock Cr.	3	2.0	15	5	20	5		25
8	Gladys R.	3	8.0		2	2			2
9	Gladys R.	2	<0.1	30	152	182			182
10	Hall L.	2	<0.1	12	10	22			22
11	Small L. #3	4	1.8	52	37	89			89
12	Gladys R.	1	16.0	67	14	81	8		89
13	Gladys L.	2	2.0	110	36	146			146
14	Gladys L.	4	<0.1	2	6	8			8
15	Gladys R.	4	12.5	40	22	62	4		66
16	Gladys R.	1	<0.1		4	4			4
17	Gladys R.	3	3.0	26		26			26
18	Eva L.	2	0.4	30	10	40			40
19	Line L.	2	<0.1	6		6			6
20	Gladys R.	3	4.4	70		70			70
21	Surprise L.	2	<0.1	30	20	50			50
22	Pine Cr.	1	<0.1	15		15			15
23	Consolation Cr.	3	12.0						0
24	Consolation Cr.	1	0.1	2		2			2
25	Fish L.	4	3.6	91	94	185	16	15	216
26	McCleary R.	3	0.2	21	14	35			35
27	McCleary R.	1	1.0	106	25	131			131

continued . . .

APPENDIX 6 continued . . .

				DUCKS					
NUMBER	LOCATION	TYPE	SIZE	Dabbling	Diving	Total+	CANADA GEESE	SWANS	TOTAL
28	Lubbock R.	1	3.1	33	24	57			57
29	Shakes L.	1	0.2						0
30	Atlin R.	1	2.0		13	13			13
31	Atlin R.	3	12.8		5	5			5
32	Graham Inlet	2	18.0	113	42	155			155
33	Indian Pt. Narrows	4	15.0	59	26	85			85
34	Golden Gate	4	< 0.1						0
35	Fantail R.	1	2.3		4	4			4
36	False L.	2	3.0		2	2			2
37	Fantail R.	3	16.0	6	2	8			8
38	Warm Cr.	1	2.0	32	4	36		1	37
39	Warm Cr.	3	2.0	70		70	4		74
40	Lowry Cr.	1	< 0.1	2		2			2
41	Deep Bay	4	0.1	30	20	50			50
42	Deep Bay	4	<0.1		1	1			1
43	Taku Arm	4	<0.1		1	1			1
44	Bucham Cr.	1	<0.1	3		3			3
45	Swanson R.	1	<0.1	21		21		1	22
46	Wann R.	1	0.1			2			2
47	Edgar L.	1	0.1			2			2
48	Nelson L.	2	0.5	55		55			55
49	Wann R.	1	0.5						0
50	Hobo Cr.	1	1.0	47	2	49			49
51	Second Narrows	4	2.0	4		4			4
52	Second Narrows	4	0.6	50	45	95			95
53	Pike R.	1	0.2	3		3			3
54	O'Donnel R.	1	0.4	20	13	33		2	35
55	Torres Channel	4	12.0		9	9			9
56	Pine Cr.	1	0.9	20	32	52			52
Total		56	418	1,535	1,211	2,750	66	59	2,875

APPENDIX 7 Site Description and Number of Waterfowl Observed on Each Open Water Area. Northern B.C., 28 April 1983. For Type, 1 = river outlet, 2 = river inlet. 3 = river channel, 4 = lake channel, 5 = sloughs. NL = not located. NO = no open water.

NUMBER	LOCATION	TYPE	DUCKS			CANADA GEESE	SWANS	TOTAL
			Dabbling	Diving	Total+			
1	Jennings R.	1	278	330	608		4	612
2	Teslin L.	4	61	171	232	45		277
3	Teslin R.	1	55	128	183	61		244
4	Hayes R.	1	54	31	95			95
5	Small L. #1	4		20	27			27
6	Small L. #2	4			30			30
7	Hitchcock Cr.	3						NL
8	Gladys R.	3		6	6			6
9	Gladys R.	2	27	20	89			89
10	Hall L.	2		6	6			6
11	Small L. #3	4	30	18	85		37	122
12	Gladys R.	1						0
13	Gladys L.	2			145			145
14	Gladys L.	4			30			30
15	Gladys R.	4	60	9	161	1		162
16	Gladys R.	1			30	12		42
17	Gladys R.	3			37			37
18	Eva L.	2			3			3
19	Line L.	2			65	14		79
20	Gladys R.	3						NL
21	Surprise L.	2						NO
22	Pine Cr.	1		10	10			10
23	Consolation Cr.	3						NO
24	Consolation Cr.	1						0
25	Fish L.	4			250	65	11	326
26	McCleary R.	3						NL

continued . . .

APPENDIX 7 continued . . .

NUMBER	LOCATION	TYPE	DUCKS Dabbling	DUCKS Diving	DUCKS Total+	CANADA GEESE	SWANS	TOTAL
27	McCleary R.	1						NL
28	Lubbock R.	1						NL
29	Shakes L.	1						NL
30	Atlin R.	1	36	109	145			145
31	Atlin R.	3	170	6	176	5		181
32	Graham Inlet	2						0
33	Indian Pt. Narrows	4	35		35			35
34	Golden Gate	4						NO
35	Fantail R.	1	2		2			2
36	False L.	2			18			18
37	Fantail R.	3						0
38	Warm Cr.	1	26	54	80			80
39	Warm Cr.	3						0
40	Lowry Cr.	1			15			15
41	Deep Bay	4		5	5			5
42	Deep Bay	4	62		62			62
43	Taku Arm	4	10	12	22			22
44	Bucham Cr.	1						NL
45	Swanson R.	1						0
46	Wann R.	1						0
47	Edgar L.	1		2	2			2
48	Nelson L.	2			37			37
49	Wann R.	1						0
50	Hobo Cr.	1						0
51	Second Narrows	4	23	2	25			25
52	Second Narrows	4						0
53	Pike R.	1						0
54	O'Donnel R.	1						NL
55	Torres Channel	4	120	80	200			200

continued . . .

APPENDIX 7 continued . . .

			DUCKS					
NUMBER	LOCATION	TYPE	Dabbling	Diving	Total+	CANADA GEESE	SWANS	TOTAL
56	Pine Cr.	1		5	5			5
57	Morley R.	1			150			150
58	Swift R.	1	30	200	230	2	1	233
59	Swift L.	2	15		45			45
60	Swift L.	1	7	10	17			17
61	Large Slough #1	5		6	6			6
62	Large Slough #2	5	338	80	665	3		668
63	Large Slough #3	5		25	25	3		28
64	Swan L.	2			185	3		188
65	Small Slough #1	5	5	1	8	6		14
66	Small Slough #2	5	25	2	31			31
67	Small Slough #3	5	75		75			75
68	Lake	4			7			7
69	Lake	4		15	15			15
70	Lake	2	4	19	23	30		53
71	Hutsigola L.	1	200	217	417			417
72	Teslin R.	3	500		800	156		956
73	Chismania L.	2	25	4	33			33
74	Chismania L.	1	15		15			15
75	Hayes R.	1		4	4			4
76	Hayes R.	1	2		142	5		147
77	Gladys R.	1	50		50	3		53
78	Bell L.	2			18			18
79	Lake narrows	4	23	1	24	1		25
Total		79	2,363	1,608	5,906	415	53	6,374

+	includes unidentified dabbling and diving ducks
NL	not located
NO	no open water

APPENDIX 8 Aquatic Plants Sampled at the Staging Sites, Summer 1982.

Water Horsetail	*Equisetum fluviatile*[*]
Scouring Rush	*Equisetum hyemale*
Marsh Horsetail	*Equisetum palustre*
Pondweed	*Potamogeton pectinatus*
Pondweed	*Potamogeton Richardsonii*
Pondweed	*Potamogeton vaginatus*
White Water-buttercup	*Ranunculus aquatilis*
Water Starwort	*Callitriche hermaphroditica*
Mare's Tail	*Hippuris vulgaris*
Water Milfoil	*Myriophyllum* spp.
Muskgrass	*Chara sp.*[†]

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[*] Scientific names of vascular plants taken from Porsild and Cody 1980.

[†] Green algae.

Appendix 9. Summary Statistics of Stepwise Multiple Linear Regression of the Number of Waterfowl on Habitat Variables - Mud, Open Water and Shallow Water.

	X-VARIABLE	F-PRIME*	R-SQUARED	F-TEST+	SIGNIFICANCE
1982					
MARSH SITE	Mud	110.6289	.9325	110.6289	P<.001
	Open Water	.0857	.9333	49.0358	P<.001
	Shallow Water	.2275	.9358	29.1589	P<.001
TAGISH SITE	Mud	2.2317	.1824	2.2317	NS
	Open Water	1.0305E-02	.1833	1.0106	NS
	Shallow Water	2.9271E-04	.1834	.5910	NS
TESLIN SITE	Open Water	.9049	8.2984E-02	.9049	NS
	Shallow Water	8.2839E-02	9.1347E-02	.4523	NS
	Mud	.0986	.1024	.3042	NS
1983					
MARSH SITE	Shallow Water	13.8225	.4343	13.8225	P<.001
	Mud	21.5719	.7507	25.5959	P<.001
	Open Water	1.9014	.7772	18.6025	P<.001
TAGISH SITE	Shallow Water	5.8780	.2957	5.8780	P<.1
	Mud	6.8568	.5389	7.5969	P<.01
	Open Water	1.8904	.6017	6.0417	P<.01
TESLIN SITE	Open water	.1724	1.2169E-02	.1725	NS
	Mud	11.7634	.4814	6.0342	P<.01
	Shallow Water	.2626	.4925	3.8822	P<.1

* F-Ratio of each X alone as it enters the regression

+ F-Ratio of one, two or three X variables in the regression

NS Not Significant

APPENDIX 10 Less Abundant and Rare Waterbird Species Observed at the Staging Sites, 16 April - 20 May 1982.

		DATE								
		APRIL				MAY				
LOCATION	WATER BIRD SPECIES	16-17	21-22	25-26	29-30	3-4	7-8	11-12	15-16	19-20
LITTE ATLIN	Common Loon									5
	Greater White-fronted Goose						13			
	Snow Goose		1							
	Blue-winged Teal									6
	Redhead							3		
	Ring-necked Duck						3	5	21	11
	Surf Scoter								5	
	White-winged Scoter								4	
	American Coot						1			1
TESLIN	Arctic Loon								10	
	Common Loon								3	11
	Snow Goose					3	1			3
	Blue-winged Teal								2	3
	Eurasian Wigeon					1				
	Redhead									2
	Ring-necked Duck							14	7	2
	Surf Scoter								6	5
	White-winged Scoter									6
	Scoter spp.						56			
	American Coot						2			
MARSH	Arctic Loon								8	
	Common Loon								5	
	Greater White-fronted Goose			4	2		2		1	
	Snow Goose								1	3
	Redhead					15	8	4	7	2

continued . . .

APPENDIX 10 continued . . .

		DATE								
		APRIL				MAY				
LOCATION	WATERBIRD SPECIES	16-17	21-22	25-26	29-30	3-4	7-8	11-12	15-16	19-20
	Ring-necked Duck								5	7
	Surf Scoter							4	30	58
	White-winged Scoter								1	25
	Scoter spp.									134
	American Coot						2			
TAGISH	Common Loon							4	42	23
	Greater White-fronted Goose					2		6	4	
	American Black Duck				1					
	Blue-winged Teal								1	2
	Eurasian Wigeon						1			
	Redhead		2	8		5	1		8	18
	Ring-necked Duck			1			1	9		9
	Harlequin Duck								4	
	Surf Scoter							7	2	3
	White-winged Scoter								2	
	Hooded Merganser					2				

APPENDIX 11 Less Abundant and Rare Waterbird Species Observed at the Staging Sites. 5 April - 26 May 1983.

		DATE											
		APRIL					MAY						
LOCATION	WATERBIRD SPECIES	5-6	10-11	18-19	22-23	27	1	5	9	13	18	22	26
TESLIN	Common Loon								2	9	7	3	
	White-fronted Goose									2			
	Eurasian Wigeon						2						
	Redhead		1			2		2					
	Ring-necked Duck					4	16	4					
	Surf Scoter										5		
MARSH	Common Loon							2				1	1
	White-fronted Goose				2								
	Blue-winged Teal										10		
	Cinnamon Teal										2		
	Redhead				22								
	Ring-necked Duck						20	21	15	1	23	2	
	Oldsquaw											25	
	Surf Scoter							4	4	8	29	55	7
	White-winged Scoter									18	12	6	4
TAGISH	Common Loon							11	4	28	3		1
	White-fronted Goose						1						
	Snow Goose											1	
	Blue-winged Teal									2	5		4
	Cinnamon Teal										1	1	2
	Redhead							1				2	3
	Ring-necked Duck			2	6		8	18		3			
	Surf Scoter							5	3	30	85	1	36
	White-winged Scoter											4	2

APPENDIX 12 Estimated Spring Waterbird Abundance at all Open Water Sites in the Southern Yukon River Basin.

Total waterbirds occurring in the southern Yukon River Basin staging sites during peak migration 22 April 1983 were extrapolated from the mean number of waterbirds observed on the minor sites in northern B.C. during the aerial survey of 28 April 1983 and the mean number of waterbirds observed on the major sites 27 April 1983.

Minor Sites in Yukon River Basin

79 sites northern B.C. (this report)
19 sites southern Yukon (Mossop 1976)

98

Major Sites in Yukon River Basin

11 sites southern Yukon (Mossop 1976)

Waterbirds During 27-28 April 1983 at all staging sites, Southern Yukon River Basin

81 (mean # waterbirds on minor sites)
X 98 minor sites = 7,938

1666 (mean # waterbirds on major sites)
X 11 major sites = 18,326

Total 26,264

Waterbirds in Southern Yukon River Basin staging Sites During Peak Migration

Correction Factor: 61% more birds at three major staging sites during peak migration.

26,264 + ([26,264 X 61] ÷ 100) = 42,285

Estimated Total Waterbirds,
Peak Migration = 42,000

APPENDIX 13 **Waterfowl Disturbances Recorded During Behaviour Watches and Census Periods, Spring, 1982.**

SITE	TYPE OF DISTURBANCE	DATE	DESCRIPTION OF DISTURBANCE	REACTION OF WATERFOWL
Little Atlin	Human	3 May	Approach on foot	Flush most of Canada Geese and 25 Pintail
		8 May	Approach on foot	Flush all birds
	Mammal	3 May	Beaver (Castor canadensis) - swims, makes several attempts to get up on ice	Goldeneye, Bufflehead, Green-winged Teal, Common Merganser not disturbed, two Green-winged Teal flush off ice short distance
	Raptor	25 April	Northern Harrier	No reaction
		29 april	Northern Harrier	One Goldeneye flush
		8 May	Northern Harrier	No reaction
		15 May	Bald Eagle, first pass	All ducks flush
			Bald Eagle, second pass	All ducks flush again
Teslin	Human	30 April	Powerboat	Swans alert, ducks feed
			Powerboat	Swans and ducks swim slowly upriver away from disturbance
		8 May	Powerboat	Birds fly short distance, swim away
	Raptor	22 April	Northern Harrier	No reaction
		26 April	Northern Harrier	No reaction
		30 April	Northern Harrier	No reaction
		30 April	Osprey	All ducks, swans - no reaction, ducks then flush again
		30 April	Bald Eagle	All ducks flush except Mallards, swans - no reaction
		30 April	Osprey	Ducks disturbed but do not flush
			Red-tailed Hawk	No reaction
		12 May	Northern Harrier	Many ducks flush (Green-winged Teal, Mallard, Wigeon, Pintail)
		16 May	Osprey	Some ducks up, short flight
Marsh	Human	27 April	Powerboat	All geese flush
		29 April	Walk on ice	Swans, geese and some ducks flush
		3 May	Walk along shore	All swans and ducks flush
		6 May	walk on ice	All swans flush, land elsewhere, within view, ducks - no reaction
		7 May	Small airplane - low flying	No reaction
	Raptor	28 April	Bald Eagle	All ducks flush, swans alert, geese short flight, ducks return in three minutes

APPENDIX 13 (continued)

SITE	TYPE OF DISTURBANCE	DATE	DESCRIPTION OF DISTURBANCE	REACTION OF WATERFOWL
Marsh	Raptor	28 April	Two Bald Eagles	All ducks flush, swans and geese - no reaction
		29 April	Goshawk	Canada Geese alert, Mallard and Common Goldeneye flush
		6 May	Bald Eagle	All swans and ducks flush
Tagish	Human	1 May	Dirt bike driven along shore	Flushes most of 200 divers and dabblers and 24 swans, some Bufflehead and Mallard linger
		9 May	Walk along shore	50% of ducks (American Wigeon and Pintail) swim slowly away
		16 May	Powerboat	25 dabblers flush
	Raptor	21 April	Bald Eagle	All ducks, geese and swans flush
		23 April	Goshawk, Northern Harrier and Bald Eagle	All ducks and geese flush, land after three minutes
		23 April	Bald Eagle	All ducks and geese flush, geese fly 600 m and stand alert for >15 minutes
		23 April	Bald Eagle	30 divers flush
		23 April	Bald Eagle	All waterfowl flush, geese land on far ice, ducks return to origin
		23 April	Bald Eagle	30 divers and gulls flush, circle and land on opposite side of the bay
		23 April	Bald Eagle	All ducks flush
		1 May	Northern Harrier	Six ducks flush
		4 May	Goshawk	American Wigeon flush
		16 May	Bald Eagle	No reaction